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# NATIVE PASTURE GRASSES OF THE UNITED STATES.

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## INTRODUCTION.

On account of the widely varying conditions, the meagerness, or often absence, of information relative to the economic value of the numerous range forage plants entering into the beef, mutton, and wool producing rations of the range animals of this country, it has become desirable that a great deal of original investigation and much compilation should be made. In order that this information may be available, it is highly desirable that it be brought together and made sufficiently comprehensive to furnish a general reference.

It was with these ideas in mind that these investigations were begun several years ago. A large part of the work has been done on the saltbushes, the legumes, the browse plants, sedges, and rushes, the nonlegume and nongrass herbaceous forages, and the miscellaneous plants from all groups.

The field work is done in connection with other investigations in the Office of Farm Management of the Bureau of Plant Industry and the laboratory work by the Cattle-Food and Grain Laboratory of the Bureau of Chemistry.

This installment of the work, dealing with a part of the grasses, treats of the most important group of native forages, but of course only a fraction of that group is included.

NOTE.—This bulletin contains the results of investigations and compilations, mainly of experiment-station literature, that will be of value to chemists, agricultural writers, and ranchmen.

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In the analyses, the methods of the Association of Official Agricultural Chemists, as published in Bulletin No. 107 of the Bureau of Chemistry, U. S. Department of Agriculture, have been employed. The analytical work in large measure was done by Mr. C. E. Goodrich, assistant chemist, Cattle-Food and Grain Laboratory. About one-fourth of the determinations were made by various other analysts in the same office.

The work is confined to the continental United States, and the references cited are mainly from departmental and experiment-station literature. Discretion has been constantly exercised in the admission of data from all sources. Many analyses found in the literature have been omitted from our compilations on account of incompleteness, doubt as to the identity of the species dealt with, evident errors, and other reasons. To obviate such uncertainties in connection with our own work, museum specimens have been preserved. These, in all cases, can be located by the aid of the serial collection number of the senior writer of this paper, given in each table as "Our sample No."

It appears that nothing is to be gained by attempting any scientific arrangement of the species discussed, and few botanical data are given. It is considered that an alphabetical arrangement will be more convenient, and that the indices to the different parts will be much more serviceable to the one using the paper than an arrangement in conformity with botanical usage.

Chemical analyses of feeds are used by all feeders in calculating rations and by investigators in performing digestion experiments. Nearly all experiment stations maintain a laboratory to make analyses of feeds in connection with their experiments on the feeding value of various farm products.

It has been shown by numerous experiments that a plant varies in composition with age. On this account care has been exercised to indicate definitely the condition of growth of the samples analyzed by us. This fact must be considered in any comparisons made. Failure to record such data is a fertile source of irregularity in much chemical work done on natural feeds.

While these analyses do not show all that is desirable, they do show relative values, when taken in connection with the notes, and they enable a comparison of the species here enumerated to be made with better known feeds. The compilations of other analyses will simplify the labors of agronomists, agriculturists, and agricultural writers generally who have occasion to employ such data.

## GENERAL CONSIDERATIONS.

It has been quite conclusively shown that the range question in this country is preeminently one of management. The greater part

of our range land capable of economical improvement through seeding with any plants whose seed can be secured successfully is worth more for farming purposes than for uncultivated pastures. Land capable of being farmed is called for; consequently, pastures capable of artificial improvement by easy displacement of native vegetation are rapidly decreasing.

The more moist situations, usually small in extent, where the use of certain seed, such as that of timothy, redtop, and bluegrass, without thorough cultivation, will produce economic results are, however, in the aggregate extensive. (Pl. II, fig. 1.) These moist mountain and other meadows can be improved greatly, and they constitute the main areas where the use of seed upon land, without placing that land under thorough cultivation, has been productive of economic results.

It is true that many introduced plants are of very great importance upon some of the western ranges to-day, but those intentionally introduced have as yet become of only minor importance, with the exception of possibly some of the bur clovers, and even these can scarcely be expected to become of greater importance than the common accidental introduction of very early date. The Australian saltbush (*Atriplex semibaccata*), from which so much was once expected, is now known to be very much restricted in importance. This is not saying that plants may not yet be found which will increase the feed upon some of the western uncultivated pastures. Every effort should be made to introduce such crops. But it is evident from past experience that over most of the native pastures of our country we must depend mostly, if not entirely, upon the native forage plants indigenous to the different regions (Pl. VII, fig. 2). It is, therefore, highly important that these natives, which are manifestly to furnish in the future, as in the past, the most important part of the feed supply of the stock ranges, should receive continuous and careful study. This paper is intended as a contribution toward a better knowledge of the problems of these feeds.

The immediate problem, as in agriculture generally, is one of production. The copious literature on the subject of native pastures which has been issued by the Department of Agriculture and the State agricultural experiment stations clearly shows that the production of feed has decreased and has been so modified upon accessible lands as to furnish a poor indication of the production and the aspect which once obtained. At present, it is only in areas where ingenuity has not yet devised adequate water supply, or where areas have been protected, that present feed production resembles the original either in quality or quantity (Pl. I, figs. 1 and 2).

## DISCUSSION OF SPECIES.

### AGROPYRON SMITHII Rydb.

*Agropyron smithii* is an important species, familiarly known as Colorado bluestem. All in all, it is undoubtedly the most important native hay grass of the western Plains region, extending into the mountains of northern Arizona. It is closely related to the quack-grass of the cultivated East, to which its habits are very comparable; like quack-grass, it is benefited by partial cultivation. For this reason throughout the Dakotas it is a familiar thing to see this species making a very decided increase in growth in the edges of cultivated fields. Here it comes in contact with the undisturbed prairies, where it once grew in abundance, either pure or mixed with the gramas and buffalo grass. In some situations, where water is available for irrigation, especially along the eastern slope of the Black Hills of South Dakota, meadows have been cut for 10 years, yielding an excellent quality of hay from this grass, to the extent of 1½ tons to the acre. Although its seed habits are good and the seed production abundant, it is seldom that it reproduces from seed under natural conditions, although under cultivation it is readily grown in this way. Indeed, upon the native prairies it is common for it not even to head out, seed production taking place only in favorable years. Its reproduction is almost entirely by running rootstocks. In 1897 crops of it were excellent throughout the Dakotas and Montana, many areas of uncultivated lowland prairies having a perfect stand and resembling fields of grain more than native hay. It certainly could be easily domesticated and might prove a valuable grass for cultivation. It has already been extensively grown in small plats by the State experiment stations and reports of it are generally favorable.

No. 8810 was collected near Fargo, N. Dak., August 10, 1907.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8810 | 7.88 | 11.58 | 2.32 | 32.27 | 43.73 | 10.10 | 24.13 |
| Average of 19 others [1] | ..... | 8.05 | 2.93 | 34.41 | 44.98 | 9.63 | ..... |
| Average of all | ..... | 8.23 | 2.90 | 34.30 | 44.92 | 9.65 | ..... |

[1] Canada Central Experiment Farm Bul. 19, pp. 28, 32. Colorado Bul. 12, p. 130. Iowa: Bul. 11, p. 464; Bul. 56, p. 465. Montana Report, 1902, p. 66. South Dakota: Bul. 40, p. 150; Bul. 114, p. 551. Wyoming: Bul. 65, pp. 10, 11; Bul. 70, pp. 11; Bul. 76, p. 11; Bul. 87, p. 14.

### AGROPYRON SPICATUM (Pursh) Rydb.

*Agropyron spicatum* is the famous "bunch-grass" of the Columbia Basin, and in many sections of that general region it covers the ground in big bunches. When undisturbed it often resembles a field of grain at a distance. Considerable work has been done by the Department of Agriculture and some of the State experiment stations in securing seed of this native species and attempting to introduce it in other situations, but with indifferent success. The difficulty has been largely one of germinating the seed. The regions in which it grows are somewhat arid, and the plant in its natural habitat is accustomed to get along without the use of seeds; in other words, it is perennial and seldom has occasion to renew from seed. Under favorable conditions of cultivation it reproduces readily. On account of greater ease in handling, selections from the awnless forms are best adapted to cultivation.

No. 8850 was collected near Summit, Mont., August 15, 1907. The sample represents the plant when the seed is in the early milk. It was cut 3 inches from the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8850 | 6.26 | 4.49 | 2.26 | 31.73 | 55.42 | 6.10 | 24.96 |
| Average of 7 others [1] | ..... | 10.67 | 3.13 | 30.71 | 49.33 | 6.16 | ..... |
| Average of all | ..... | 9.90 | 3.02 | 30.84 | 50.09 | 6.15 | ..... |

[1] Colorado Bul. 12, p. 65; Oregon Report, 1903, p. 47; Washington Bul. 72, p. 15; Wyoming Bul. 76, p. 16.

### AGROPYRON TENERUM Vasey.

*Agropyron tenerum* is generally known as slender wheat-grass in experiment-station and departmental literature. It has been given considerable prominence as a promising grass for cultivation, and its seed has been placed on the market by seed firms. It has good habits, makes a good quality of hay, and is palatable to stock. There are many varieties of it, some of the natives from the Rocky Mountain region being much ranker and taller in their habits of growth than the forms which have been upon the market.

No. 8791 was collected near Fargo, N. Dak., August 8, 1907. No. 8837 was collected at Havre, Mont., August 13, 1907. This sample was a tall, rank, robust form, growing in large bunches; it was mature, but all green except the heads.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8791 | 6.64 | 6.65 | 2.62 | 33.73 | 50.10 | 6.90 | 25.88 |
| Our sample No. 8837 | 5.41 | 6.64 | 3.24 | 37.49 | 46.49 | 6.14 | 26.49 |
| Average of 9 others [1] | ..... | 7.17 | 2.07 | 34.79 | 47.73 | 8.24 | ..... |
| Average of all | ..... | 7.08 | 2.23 | 34.94 | 47.82 | 7.93 | ..... |

[1] Canada Central Experiment Farm Bul. 19, pp. 28–29. Colorado Bul. 12, p. 64. Montana Report, 1902, p. 66. South Dakota: Bul. 40, p. 147; Bul. 69, p. 27. Wyoming: Bul. 65, p. 14; Bul. 87, p. 15.

### AGROSTIS ASPERIFOLIA Trin.

*Agrostis asperifolia* (rough-leaved bent-grass) is especially common in moist situations from the Mississippi River westward. It is readily grazed by all classes of live stock, but is never abundant enough to receive serious consideration. It inhabits the edges of running streams or fresh-water pools, where the ground may be covered with water for some little time. In such situations small patches of it grow, but the areas are never extensive.

No. 8867 was collected near Summit, Mont., August 15, 1907. This sample was collected in blossom and cut close to the ground. No. 8890 was collected at Hood River, Oreg., August 23, 1907. The seeds in the sample were all ripe, and half of the leaves were dry. This sample was cut 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8867 | 5.86 | 6.55 | 2.33 | 32.60 | 45.93 | 12.59 | 23.51 |
| Our sample No. 8890 | 5.56 | 15.03 | 1.97 | 30.26 | 47.71 | 5.03 | 22.18 |
| Average of 4 others [1] | ..... | 8.11 | 2.64 | 24.89 | 53.95 | 10.41 | ..... |
| Average of all | ..... | 9.01 | 2.47 | 27.07 | 51.57 | 9.88 | ..... |

[1] Colorado Bul. 12, p. 40; Connecticut Report, 1879, p. 155; Montana Report, 1902, p. 66; U. S. Department of Agriculture Report No. 32, 1884, p. 127.

### AGROSTIS HIEMALIS (Walt.) B. S. P.

*Agrostis hiemalis* (bent-grass) is very likely to take possession of situations in the mountains which for some reason have become completely denuded of other vegetation. Its extensive purplish panicles make it very conspicuous in such places, for it often grows almost pure. It is a species of comparatively little value, although often grazed in close pastures.

No. 8847 was collected at Summit, Mont., August 15, 1907. The sample was collected in late blossom and cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8847 | 5.62 | 7.31 | 4.85 | 30.03 | 51.85 | 5.96 | 24.70 |
| Average of 4 others [1] | ..... | 7.18 | 2.96 | 32.30 | 48.96 | 8.60 | ..... |
| Average of all | ..... | 7.21 | 3.34 | 31.84 | 49.54 | 8.07 | ..... |

[1] South Dakota Bul. 40, p. 81. Wyoming: Bul. 70, p. 18; Bul. 87, p. 19.

### ALOPECURUS FULVUS Sm.

*Alopecurus fulvus* is a much smaller species of foxtail than the one that follows and is of much less importance. It inhabits low, wet, loose soils of high mountain meadows, and, like the other species, it sheds its seeds from the top downward immediately after they ripen. It may often be found growing in the water, but not in stagnant pools. While furnishing considerable feed in limited areas, it is not nearly as important as the other species. (Pl. II, fig. 2.)

No. 8864 was collected at Summit, Mont., August 15, 1907. The sample was perfectly green and succulent, although half of the seeds had dropped off. It was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8864 | 7.87 | 6.90 | 2.89 | 29.51 | 52.39 | 8.31 | 20.39 |
| Average of 2 others [1] | ..... | 12.12 | 3.75 | 27.19 | 46.64 | 10.30 | ..... |
| Average of all | ..... | 10.38 | 3.46 | 27.97 | 48.55 | 9.64 | ..... |

[1] South Dakota Bul. 40, p. 72; Wyoming Bul. 70, p. 23.

### ALOPECURUS OCCIDENTALIS Scribn.

*Alopecurus occidentalis* (mountain foxtail) is an important grass in high mountain meadows of the Rocky Mountain region. It resembles more closely than any other common grass the cultivated timothy. It frequently makes practically pure crops of considerable extent in wet situations. It commonly attains a height of 2½ feet and will often yield 2 tons of hay to the acre. The areas where it grows most satisfactorily are usually too wet to be either grazed or cut in early summer, but by August, when the grass matures, these are often so well dried up that they can be harvested. It is probably more valuable for hay than for grazing.

No. 8862 was collected at Summit, Mont., August 15, 1907. The specimen was overripe, about half of the seeds had fallen, but the culms and leaves were still green. It was cut about 2 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8862 | 5.04 | 6.29 | 2.15 | 29.91 | 54.08 | 7.57 | 23.53 |
| One other sample [1] | ..... | 7.06 | 2.57 | 28.41 | 54.37 | 7.59 | ..... |
| Average of both | ..... | 6.68 | 2.36 | 29.16 | 54.22 | 7.58 | ..... |

[1] Montana Report, 1902, p. 66.

### ANDROPOGON FURCATUS Muhl.

*Andropogon furcatus* (big bluestem) is very characteristic of the grass flora of the prairie region of the Great Plains, but its distribution is much wider than this. It is particularly abundant in the edges of bottom lands in the Dakotas and Montana, but farther south and east, where the rainfall is more abundant, it inhabits the open prairies and uplands. Very good pasture is produced by it early in the season, but after the stems begin to stretch it is not particularly relished by stock. It is one of the important ingredients of prairie hay from the Dakota-Oklahoma region and is considered of fair quality. The species withstands burning better than almost any other grass. While mowing to rid the ground of the old dead stems would undoubtedly be conducive to better growth, it has withstood repeated burnings throughout central Kansas and Nebraska for a great many years and still produces well.

No. 8827 was collected at Williston, N. Dak., August 11, 1907. The sample was in early maturity and was cut close to the ground. It contained, therefore, the entire culm and all the root leaves, which are abundant.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8827 | 4.73 | 5.83 | 1.89 | 33.87 | 54.15 | 4.26 | 28.24 |
| Average of 19 others [1] | ..... | 6.70 | 3.26 | 33.81 | 49.09 | 7.14 | ..... |
| Average of all | ..... | 6.66 | 3.19 | 33.81 | 49.35 | 6.99 | ..... |

[1] Canada Central Experiment Farm Bul. 19, p. 32. Colorado Bul. 12, p. 96. Connecticut Report, 1887, p. 103. Iowa: Bul. 11, p. 458; Bul. 56, p. 474. Mississippi Report, 1895, p. 90. South Dakota Bul. 40, p. 28. U. S. Department of Agriculture Report No. 32, 1884, p. 126. West Virginia Report, 1890–91, p. 36.

### ANDROPOGON SCOPARIUS Michx.

*Andropogon scoparius* is a species of bluestem easily distinguished from the preceding by its greater tendency to grow in bunches and its smaller stature throughout. Its distribution is not essentially different from the larger species; likewise, it has a purplish color early in the season. While grazed readily before it begins to head, it gets woody even earlier than *A. furcatus* and then is not relished. It is not large enough to amount to much as a hay crop.

No. 8825 was collected at Williston, N. Dak., August 11, 1907. The sample was cut close to the ground and represents the plant in early maturity.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8825 | 5.48 | 6.19 | 2.36 | 32.95 | 53.87 | 4.63 | 26.69 |
| Average of 18 others [1] | ..... | 6.05 | 2.29 | 34.47 | 51.15 | 6.04 | ..... |
| Average of all | ..... | 6.05 | 2.29 | 34.39 | 51.31 | 5.96 | ..... |

[1] Canada Central Experiment Farm Bul. 19, p. 32. Connecticut Report, 1879, p. 153; 1887, p. 103. Iowa: Bul. 11, p. 460; Bul. 56, p. 476. Mississippi Report, 1895, p. 90. South Dakota Bul. 40, p. 26. U. S. Department of Agriculture Report No. 32, 1884, p. 126. Wyoming Bul. 87, p. 24.

### ANDROPOGON SCRIBNERIANUS Nash.

*Andropogon scribnerianus*, the beautiful bluestem of the dry pine regions of Florida and adjacent States, furnishes considerable feed early in the season, but, like the remainder of the bluestems, the feed is of second quality.

No. 8725 was collected near Jacksonville, Fla., June 8, 1907. The sample was secured in full blossom, the plants being cut at the surface of the ground. Its percentage of moisture was 5.66. Other constituents (on a water-free basis) were as follows: Ash, 3.02; ether extract, 2.11; crude fiber, 39.38; nitrogen-free extract, 51.87; protein, 3.62; pentosans, 28.44.

### ANDROPOGON TORREYANUS Steud.

*Andropogon torreyanus* (white-topped beard-grass) is conspicuous upon prairies, in the edges of swales, upon railroad embankments, and along roadsides where the ground has been stirred or there is an accumulation of moisture, from Arizona to eastern Texas and northward to Kansas and Nevada. It furnishes a large amount of grazing, and in some situations, even in the valleys of southern Arizona, it furnishes at times considerable crops of hay. While common upon the prairies in the eastern limit of its range, in more arid regions it grows mainly in depressions or in places which receive an accumulation of water from the nature of the surface drainage. In the desert regions it is strictly a summer grass, starting to grow about the first of July and maturing its seed in late September or early October, corresponding with the rainy season. Farther east, in Texas, its period of development is entirely different. There it may mature as early as June.

Under proper conditions it grows readily from seed, and were it not for the fact that its seed habits are poor (that is, the seeds are difficult to gather) it would be a promising grass for cultivation. Like many other valuable native species, however, its seed habits are such that it would be very difficult indeed to thrash the plants after they are harvested, although the seed itself is produced in good quantity and is unusually fertile. The grass is peculiar in having a distinctly characteristic and pleasing aroma. (Pl. IV. fig. 1.)

No. 8394 was collected near Green, Tex., August 14, 1906. The sample was a trifle overripe; about half of the seed had fallen, but the plant was still green. A few dead leaves were attached to the lower part of the clump, which was cut 2 or 3 inches above the ground. Its percentage of moisture was 8.37. Other constituents (on a water-free basis) were as follows: Ash, 7.16; ether extract, 1.64; crude fiber, 36.78; nitrogen-free extract, 48; protein, 6.42; pentosans, 23.51.

### ANDROPOGON VIRGINICUS L.

*Andropogon virginicus*, the broom sedge of the East and South, is commonly looked upon as a pernicious weed which gradually works into permanent pastures and neglected places, driving out more valuable plants. Still it is persistent and furnishes a great deal of fairly good pasture early in the season, and it often enters into the composition of hay upon long-established meadows.

No. 8727 was collected near St. Petersburg, Fla., June, 1907. The sample consisted of root leaves only from burned-over ground; consequently, the analysis represents a most favorable composition.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8727 | 8.29 | 8.40 | 3.70 | 33.57 | 44.48 | 9.85 | 23.89 |
| Average of 6 others [1] | ..... | 6.80 | 2.11 | 37.04 | 47.82 | 6.23 | ..... |
| Average of all | ..... | 7.03 | 2.33 | 36.54 | 47.35 | 6.75 | ..... |

[1] Connecticut Report, 1879, p. 153; 1887, p. 103. Mississippi Report, 1895, p. 90. North Carolina Bul. 90b, p. 5. U. S. Department of Agriculture Report No. 32, 1884, p. 126. Virginia Bul. 180, p. 96.

FIG. 1.—A PRIMITIVE WAY OF PUMPING WATER FOR STOCK ON THE MEXICAN BORDER.

FIG. 2.—A COMMON WAY OF IMPOUNDING THE RUN-OFF WATER FOR STOCK PURPOSES.

FIG. 1.—A WEEDY MOUNTAIN MEADOW IN CALIFORNIA, WHERE THE SEEDING OF TIMOTHY AND REDTOP WOULD BE HIGHLY ADVANTAGEOUS.

FIG. 2.—ALOPECURUS FULVUS IN A POCKETLIKE DEPRESSION IN THE GRAND COULEE, WASH.

### ARISTIDA CALIFORNICA Thurber.

In southern Arizona *Aristida californica*, a species of needle grass, is of some value, occupying, as it does, gravelly ridges of the foothills. It is closely grazed by cattle and commonly makes two appreciable crops during the year. The main growth, of course, is in the summer rainy season, but there is usually a considerable development of root leaves in the spring, which is not true of many of the perennial species of this region. Its perennial culms add decidedly to its value.

No. 9588 was collected in the Santa Rita Mountains of Arizona, September 16, 1908. Its percentage of moisture was 3.27. Other constituents (on a water-free basis) were as follows: Ash, 8.05; ether extract, 0.90; crude fiber, 34.50; nitrogen-free extract, 50.54; protein, 6.01; pentosans, 25.67.

### ARISTIDA LONGISETA Steud.

*Aristida longiseta*, a species of poverty grass, is very conspicuous on dry hills and rolling prairies of the western Plains and Rocky Mountain region, extending southward to northern Arizona. Very often large areas may be seen, but it seldom grows pure. While it sometimes reaches a foot in height, it is commonly only about 6 inches. This, however, depends upon the season and the character of the locality in which it grows, the drier situations producing, of course, much smaller plants. It is readily grazed with other vegetation in both dry and green conditions, except for a short period after the plant approaches maturity, when the awns are troublesome.

Nos. 7089 and 7090 (Wooton) were collected near Las Cruces, N. Mex., October 4, 1912. No. 8873 was collected near Kalispell, Mont., August 16, 1907. This sample was in late blossom; some old leaves were included, and it was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7089 (E. O. W.) | 3.55 | 9.71 | 1.56 | 35.40 | 44.32 | 9.01 | 26.63 |
| Our sample No. 7090 (E. O. W.) | 2.60 | 8.40 | 1.32 | 36.79 | 45.47 | 8.02 | 27.39 |
| Our sample No. 8873 | 5.73 | 5.82 | 1.51 | 33.73 | 52.70 | 6.24 | 28.54 |
| One other sample [1] | ..... | 8.47 | 1.31 | 41.55 | 42.21 | 6.46 | ..... |
| Average of all | ..... | 8.10 | 1.42 | 36.87 | 46.18 | 7.43 | ..... |

[1] Wyoming Bul. 87, p. 26.

### ARISTIDA MICRANTHA (Vasey) Nash.

In southern and southwestern Texas *Aristida micrantha* furnishes half of the grazing over large areas and is a persistent palatable species, growing in large tufts about 15 inches high. Generally it grows best in open brushy regions and in reasonably fertile loamy soils. This is one of the few grasses of the Southwest which has perennial stems; for this reason its value on a previously unstocked range is apt to be overestimated.

No. 8387 was collected at Encinal, Tex., August 12, 1906. The sample was fully mature, was cut at the surface of the ground, and contained about 5 per cent of old growth.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8387 | 8.88 | 11.37 | 1.43 | 31.60 | 49.36 | 6.24 | 24.90 |
| One other sample [1] | ..... | 6.85 | 2.59 | 24.88 | 61.36 | 4.32 | ..... |
| Average of both | ..... | 9.11 | 2.01 | 28.24 | 55.36 | 5.28 | ..... |

[1] U. S. Department of Agriculture Report No. 32, 1884, p. 126.

### ARISTIDA SCABRA Kth.

*Aristida scabra* is closely related to *A. scheidiana*, but is a larger, coarser plant, commonly inhabiting the 4,500 to 5,000 foot levels of the mountains of southern Arizona, where it grows mostly in large, isolated bunches. Inhabiting as it does rough, rocky hill and mountain sides, it is not usually grazed as closely as the other species and probably is not quite as good feed.

No. 8590 was collected in the Santa Rita Mountains, Ariz., September 27, 1906. The specimen was completely dried up with the exception of a small portion near the base. It was harvested about 3 inches high. Its percentage of moisture was 4.62. Other constituents (on a water-free basis) were as follows: Ash, 7.15; ether extract, 1.54; crude fiber, 31.59; nitrogen-free extract, 53.37; protein, 6.35; pentosans, 25.49.

### ARISTIDA SCHEIDIANA (T. and R.) Vasey.

*Aristida scheidiana*, a species of needle grass, is abundant from western Texas to Arizona. It inhabits, in Arizona especially, the upper foothill regions and extends in many instances into the mountains to an altitude of about 6,000 feet. Often the amount of feed produced by it is unequaled in quantity by any other species over considerable areas. It is at present invariably closely grazed, and in situations where the ground is not too rough it could be made into hay of fair quality at the rate of a ton to the acre. It is most abundant in the open foothills of the isolated mountain ranges at an altitude of about 4,000 feet. It is now seldom conspicuous upon the open range, because it appears to be quite easily injured by trampling and close grazing. In the large inclosure made by the Department of Agriculture in the Santa Rita Mountains several years ago it is exceedingly abundant and productive over considerable areas, and it produces probably as heavily to the acre as any other species which grows in as pure stands as this does.

Although the whole genus Aristida is commonly referred to as poverty grass and consists usually of species which produce a poor quality of feed, this one is a decided exception. It is perennial in character, produces a good quantity of leaves, and, although quite rigid and hard, is evidently relished by stock. However, it is not grazed nearly as readily as the gramas with which it is commonly associated.

No. 9521 was collected at Prescott, Ariz., August 31, 1908. The sample was in blossom, and cut between 2 and 3 inches high. Its percentage of moisture was 6.93. Other constituents (on a water-free basis) were as follows: Ash, 7.20; ether extract, 2.55; crude fiber, 34.89; nitrogen-free extract, 49.71; protein, 5.65; pentosans, 24.59.

### AVENA BARBATA Brot.

*Avena barbata* is botanically a different species of wild oats from the one that follows, but to the rancher this is unimportant, since no distinction is popularly made between them in the California region. Both are known under the same name. This differs in having a little stricter and narrower panicle and a smaller and narrower seed, while the brown hairs with which both are clothed are somewhat less prominent and lighter in color.

No. 8264 was collected at Colton, Cal., May 8, 1906, when the entire plant was green and most of the seed in the milk condition. The plants were pulled up and the roots then cut off below the lower leaves, which were all preserved. The sample grew in a rather favorable situation; consequently, it was greener than most of the plants upon the native ranges. No. 8313 was collected at Garvanza, Cal., May 19, 1906. The sample was cut about 3 inches high and was in about the same stage of maturity as No. 8264.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8264 | 5.26 | 7.26 | 2.69 | 36.56 | 44.78 | 8.71 | 24.58 |
| Our sample No. 8313 | 6.45 | 8.06 | 2.68 | 36.27 | 47.38 | 5.61 | 25.16 |
| Average of both | 5.86 | 7.66 | 2.69 | 36.41 | 46.08 | 7.16 | 24.87 |

### AVENA FATUA L.

*Avena fatua*, commonly known as wild oats, is a weedy grass introduced from European countries. It is rather common in cultivated fields in all of the small-grain regions of the West. In California it is especially abundant, having found conditions favorable for its spread and development upon uncultivated lands, where it often forms an almost pure stand. There it is made into hay, often yielding 1 to 1½ tons to the acre of excellent forage, if cut in season. It is an annual, reproducing from seed each season. This limits its value as a range plant to the regions which are turfless, for the seed could not become sufficiently covered or, if covered, could not gain a foothold and thrive in competition with perennial grasses which form a turf. In California, where it attains its best growth, it is a winter annual, maturing its seed about May. Without doubt it should be classed as one of the most important wild forage plants of California from both a grazing and a hay standpoint. The curing of the hay to produce the best quality is considered to be more difficult than with many crops. However, in a region like the one in which it grows this is not a serious matter, for the atmosphere is dry and rains have usually ceased before the crop is ready to cut.

The plant is found rather frequently in the mountains of southern Arizona, especially in the Huachucas, where it was doubtless introduced by the military operations conducted there, but it does not find conditions suitable to its becoming sufficiently abundant to produce any appreciable quantity of feed. The mountains receive only sufficient rainfall for it to grow at all, and they are too cold for its winter development; consequently, only a few plants in favored localities are able to thrive. Upon the open lands of the foothills and deserts the rainfall is insufficient and occurs in too hot a season for it to thrive. Experiments conducted in the Santa Rita Mountains in the introduction of this grass upon native pastures have yielded only negative results. In occasional seasons a few stray plants mature in favored situations, but around cabins and in small irrigated gardens plants are frequently seen. It is also abundant in the Pacific Northwest.

No. 8301 was collected near Banning, Cal., May 15, 1906; in early maturity, but straw still green; cut about 3 inches above ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8301 | 8.79 | 11.23 | 3.60 | 29.86 | 47.42 | 7.89 | 25.09 |
| Average of 11 others[1] | ..... | 7.98 | 3.14 | 30.61 | 51.28 | 6.99 | ..... |
| Average of all | ..... | 8.25 | 3.18 | 30.55 | 50.95 | 7.07 | ..... |

[1] California Bul. 132, p. 5. Oregon Report, 1904–5, p. 70. Washington: Bul. 72, p. 17; Bul. 82, p. 10.

### BOUTELOUA ARISTIDOIDES (H. B. K.) Thurber.

*Bouteloua aristidoides* is one of the "six weeks' grasses" of the Southwest and has a wide distribution from Texas to California and south to South America. It is an annual with seed habits perfectly adapted to make it an aggressive plant in an unsodded region. Being an annual, its forage is of low value, but its seed production is large. It occupies the lower foothills and mesas in the southwestern United States, and when the season is favorable it makes nearly a ground cover over extensive areas and reaches the higher altitudes of 6,000 feet or more. Like many annuals, it pulls up readily; consequently, it is not relished by stock even in the green stage, although extensively grazed then and in the dry condition when other feed is scarce. During its maturity it is especially annoying to sheep on account of the spikes, which fall readily and penetrate the fleece and feet of the animals, sometimes disabling them. In spite of these drawbacks, however, it is extensively grazed, and in many situations, where the more

valuable grasses have been exterminated, it constitutes the main feed, aside from that furnished by the shrubs. (Pl. III, fig. 2.)

No. 9618 was collected in the Santa Rita Mountains of Arizona, September 22, 1908. The sample was mature, but only a few spikes had fallen off. It was cut close to the ground. Its percentage of moisture was 2.44. Other constituents (on a water-free basis) were as follows: Ash, 6.84; ether extract, 2.12; crude fiber, 35.11; nitrogen-free extract, 46.96; protein, 8.97; pentosans, 23.16.

### BOUTELOUA BURKII Scribn.

*Bouteloua burkii*, a species of grama, is one of the most abundant of the pasture grasses of central to southern Texas. It is a perennial, seldom growing over 10 inches high, and usually only about 6 inches, but it produces an abundance of root leaves and furnishes a very large percentage of the forage of the native pastures of the region. It never gets large enough to be considered as a hay crop. Like the vast majority of gramas its seed habits render it useless for cultivation.

No. 8398 was collected near Green, Tex., August 14, 1906. The sample was overripe, the seed having all fallen, and half of the plant was dead and dry. It was cut close to the ground. Its percentage of moisture was 6.81. Other constituents (on a water-free basis) were as follows: Ash, 12.89; ether extract, 1.82; crude fiber, 30.54; nitrogen-free extract, 46.70; protein, 8.05; pentosans, 22.13.

### BOUTELOUA CURTIPENDULA (Michx.) Torr.

*Bouteloua curtipendula*, the side-oat grama, as it is popularly called, is the most promising of the gramas for cultivation. It makes a taller, ranker growth than any of the other species, but like the others has poor seed habits for an agricultural grass. It has a wider distribution in the United States than any of the other gramas except, possibly, *B. hirsuta*, which is of much less value. Some efforts have been made to domesticate it, and this species is one that was always included in the tests made during the grass-garden period of experimentation of 12 to 15 years ago. A stand of it is not difficult to obtain from seed, but in all cases of cultivation whole spikes, as they were stripped from the plant, were invariably sown or drilled in. The separation of pure, clean seed is not to be considered.

The species is conspicuous and is an important pasture plant mainly upon the rougher portions of the Plains region. In southern Arizona it inhabits similar situations at altitudes mainly between 3,000 and 5,000 feet. However, when sown and furnished sufficient water, it thrives upon the desert mesas at 2,000 feet or less. The controlling factor in its growth is moisture. When this is properly supplied, it adapts itself to almost all other conditions.

No. 8589 was collected on the north slope of the Santa Rita Mountains of Arizona September 27, 1906. The straw in this sample was ripe and dry; some of the seed had fallen.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8589 | 4.60 | 8.31 | 1.59 | 32.49 | 53.28 | 4.33 | 25.88 |
| Average of 5 others [1] | | 9.76 | 1.85 | 37.76 | 45.05 | 5.58 | |
| Average of all | | 9.63 | 1.94 | 32.86 | 49.23 | 6.34 | |

[1] Colorado Bul. 8, p. 11; Iowa Bul. 56, p. 461; New Mexico Bul. 17, p. 36; Wyoming Bul. 87, p. 28.

### BOUTELOUA ERIOPODA Torr.

*Bouteloua eriopoda*, the black grama of New Mexico and the woolly-foot of other regions, is a species of varying importance from Colorado south and from Texas to California. Over the greater portion of its range it is strictly a pasture grass, but in portions of southern New Mexico it is frequently cut for hay in almost pure stands from the upper, open

grassy mesa slopes just below and extending to the foothills of the mountains. In southern Arizona it is also limited to gravelly ridges, the better soils of the gently sloping mesas being occupied by other species. However, the present distribution may be largely the result of artificial conditions of grazing. There are indications that the species will occupy greater areas when stock is kept off, probably simulating conditions which once existed. Where it grows in sufficient abundance, it is very valuable during long droughts, on account of the perennial character of its culms. On this account, also, it is more likely to be injured during the dry season by close grazing.

No. 8946 was collected in the Santa Rita Mountains of southern Arizona, September 24, 1907. The sample was nearly mature and was cut 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8946 | 7.38 | 9.20 | 1.68 | 34.22 | 49.84 | 5.06 | 23.96 |
| One other sample[1] | ..... | 11.34 | 1.79 | 33.61 | 47.69 | 5.57 | ..... |
| Average of both | ..... | 10.27 | 1.74 | 33.92 | 48.76 | 5.31 | ..... |

[1] New Mexico Bul. 17, p. 36.

### BOUTELOUA FILIFORMIS (Fourn.) Griff.

*Bouteloua filiformis* is another grama of good quality which furnishes a large amount of feed in about the same situations as *B. rothrockii*, but at rather higher elevations. Next to *B. gracilis* it is probably the most important pasture species of this important genus, furnishing a large quantity of most palatable grazing, and at times it is cut for hay. It is one of the important species of southern Texas and extends from there to Arizona and southward far into Mexico. Along the entire Mexican border, from Laredo to Quitovaquito, it is one of the most important pasture grasses. It stands trampling a little better than *B. rothrockii*, but not nearly as well as *B. gracilis*.

No. 8591 was collected in the northern foothills of the Santa Rita Mountains of Arizona, September 21, 1906. The sample was completely dried up when gathered and was cut close enough to include all the root leaves. Its percentage of moisture was 4.48. Other constitutents (on a water-free basis) were as follows: Ash, 7.64; ether extract, 1.87; crude fiber, 30.94; nitrogen-free extract, 54.84; protein, 4.71; pentosans, 26.07.

### BOUTELOUA HIRSUTA Lag.

*Bouteloua hirsuta* (rough grama) occurs between the Mississippi and the Rockies from British Columbia southward, reaching its highest perfection and importance from the southern Plains region southward far into Mexico. It also occurs in many places east of the Mississippi and is abundant in some parts of the prairie regions of Florida. The habits of the species render it of much less value than its close relative, the blue grama, but on account of its very wide distribution and abundance as a filler over large areas it is a very important species. It is not a well-rooted species, and consequently does not withstand trampling by stock very well.

No. 8951 was collected in the Santa Rita Mountains, Ariz., September 23, 1907. The sample was cut close, in nearly mature condition.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8951 | 5.97 | 12.01 | 2.62 | 37.10 | 41.62 | 6.65 | 23.75 |
| One other sample[1] | ..... | 10.14 | 2.55 | 32.84 | 48.59 | 5.88 | ..... |
| Average of both | ..... | 11.07 | 2.59 | 34.97 | 45.10 | 6.27 | ..... |

[1] South Dakota Bul. 40, p. 97.

### BOUTELOUA PARRYI (Fourn.) Griff.

*Bouteloua parryi* (hairy grama) never occurs in sufficient abundance to be a first-quality grass, but it often furnishes half or more of the feed on small areas. It has several more or less distinct habits, like many other species of the genus. In favorable situations it may become 2 feet high, while in barren situations the whole plant may not be over 2 or 3 inches tall. It is one of the most handsome grasses of the genus, of good grazing quality, but of minor economic importance on account of its sparse growth.

No. 7095 (E. O. W.) was collected in the northern foothills of the Santa Rita Mountains of Arizona, October 9, 1912. Its percentage of moisture was 3.49. Other constituents (on a water-free basis) were as follows: Ash, 7.96; ether extract, 1.90; crude fiber, 35.56; nitrogen-free extract, 48.58; protein, 6.00; pentosans, 26.13.

### BOUTELOUA ROTHROCKII Vasey.

In some situations in southern Arizoza *Bouteloua rothrockii* (mesa grama) makes almost pure stands over large areas of the gently sloping upper mesas, just below the mountain foothills. It is especially abundant on the northern slopes of the Santa Rita and Santa Catalina mountains. In favorable seasons it often yields a ton of hay to the acre. It is a very handsome, tall species, growing rather thinly, but under protection from overgrazing—as has been done in the Santa Rita Mountains—it has thickened up wonderfully and crowded out the less valuable *Bouteloua aristidoides* and *Aristida bromides*, which had gained ascendency. It does not stand trampling as well as some of the other species of the genus and as a consequence does not yield abundantly today in many situations where it formerly predominated. (Pl. III, fig. 1.)

No. 8592 was collected on the northern slope of the Santa Rita Mountains, Ariz., September 27, 1906. The sample was taken after the plant had completely dried up, but the seed had not yet shattered. Its percentage of moisture was 3.55. Other constituents (on a water-free basis) were as follows: Ash, 6.53; ether extract, 1.58; crude fiber, 36.67; nitrogen-free extract, 50.55; protein, 4.67; pentosans, 25.68.

### BROMUS CARINATUS HOOKERIANUS (Thurb.) Shear.

*Bromus carinatus hookerianus* is rather coarse, tall brome-grass, which adds a great deal to the feed in the region where the sample was collected. It grows scatteringly and also often inhabits very limited areas to the exclusion of practically everything else. It is regularly grazed by cattle in this section, even when old, and probably does not differ materially in pasture value from some of the cultivated species, but it has a decided advantage over the weedy introduced annuals which occupy the greater part of the land in this region.

No. 8302 was collected near Banning, Cal., May 15, 1906. The seed of the sample was nearly mature. The culms were cut about 2 inches from the ground. Its percentage of moisture was 7.01. Other constituents (on a water-free basis) were as follows: Ash, 9.36; ether extract, 2.52; crude fiber, 29.20; nitrogen-free extract, 53.62; protein, 5.30; pentosans, 24.28.

### BROMUS HORDEACEUS L.

*Bromus hordeaceus*, a species of cheat, cultivated as a hay grass in some sections, is an important introduced annual weed of California west of the Sierras. It makes a fair quality of feed and is adapted for either pasture or hay. It does not possess the disadvantageous characteristics of the tucolote and some of the other species.

No. 7107 (Wooton) was collected at Red Bluff, Cal., April 7, 1913. No. 8315 was collected near Santa Barbara, Cal., May 21, 1906. The sample was taken when the seed was in the milk. It was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7107 (E. O. W.) | 6.30 | 8.37 | 2.86 | 27.60 | 50.83 | 10.34 | 21.78 |
| Our sample No. 8315 | 6.70 | 9.46 | 1.66 | 36.81 | 42.99 | 9.08 | 25.18 |
| Average of 5 others [1] | ..... | 11.49 | 5.60 | 28.53 | 37.34 | 17.04 | ..... |
| Average of all | ..... | 11.15 | 4.95 | 29.91 | 38.28 | 15.71 | ..... |

[1] Iowa Bul. 56, p. 443.

### BROMUS MARGINATUS Nees.

The distribution of *Bromus marginatus*, a native species of brome-grass, is not remarkably different from that of *B. richardsoni*, and the quality of the feed produced by the two is somewhat similar, but this species is much coarser than the other.

No. 8846 was collected near Summit, Mont., August 15, 1907. The seed was in early dough and the plant was cut 2 inches high. No. 8887 was collected near Dee, Oreg., August 23, 1907. The sample was fully mature, the upper part of the culm being dead and dry, but the leaves were all green. It was cut about 3 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Ntrogein-free extract. | Protein. | Pentosans. |
| Our sample No. 8846 | 6.23 | 6.89 | 1.91 | 35.10 | 49.91 | 6.19 | 23.97 |
| Our sample No. 8887 | 7.34 | 10.55 | 2.07 | 40.11 | 42.99 | 4.28 | 21.22 |
| Average of 14 others [1] | ..... | 10.65 | 3.61 | 29.93 | 40.05 | 15.76 | ..... |
| Average of all | ..... | 10.41 | 3.41 | 30.89 | 40.85 | 14.44 | ..... |

[1] Iowa: Bul. 11, pp. 465, 474; Bul. 56, p. 440. Montana Report, 1902, p. 66. Nevada Bul. 71, p. 23. South Dakota Bul. 69, p. 13. Wyoming: Bul. 70, p. 28; Bul. 76, p. 22.

### BROMUS POLYANTHUS Scribn.

*Bromus polyanthus* is a valuable tufted perennial species of brome-grass, inhabiting the open wooded areas of the Rocky Mountains. It has a wide distribution in the West, extending northward to Saskatchewan. So far as known, it never forms anything like a complete stand, but on the contrary is found in isolated patches scattered among other species. It is, however, an important component of the pasture lands, mountain meadows, and dry hillsides throughout the region. In the San Francisco highlands it has been practically killed out by grazing except where protected.

No. 8860 was collected near Summit, Mont., August 15, 1907. The seed of this sample was in milk, and the plants were harvested about 3 inches high. No. 9536 was collected in Prescott, Ariz., September 1, 1908. This sample was in late blossom and was cut 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8860 | 4.22 | 4.12 | 2.04 | 34.01 | 53.24 | 6.59 | 25.00 |
| Our sample No. 9536 | 6.39 | 10.88 | 1.59 | 37.56 | 41.89 | 8.08 | 19.38 |
| One other sample [1] | ..... | 5.57 | 1.71 | 35.09 | 47.22 | 10.41 | ..... |
| Average of all | ..... | 6.86 | 1.78 | 35.55 | 47.45 | 8.36 | ..... |

[1] Wyoming Bul. 87, p. 32.

### BROMUS RUBENS L.

While not possessing the deleterious characteristics described under *Bromus villosus* to quite as serious a degree, *B. rubens* nevertheless causes considerable injury in the same way. On the whole, it is a grass of very little value. It is not as good feed as *B. villosus* in either its early or its mature stages. The injuries caused by it are not quite so pronounced, but the ranges would undoubtedly be better off without it.

No. 8263 was collected near Colton, Cal., May 8, 1906. The sample was mature and harvested about 1 inch high. Its percentage of moisture was 5.02. Other constituents (on a water-free basis) were as follows: Ash, 4.16; ether extract, 2.07; crude fiber, 33.24; nitrogen-free extract, 55; protein, 5.53; pentosans, 28.20.

### BROMUS VILLOSUS Forsk.

*Bromus villosus*, a weedy annual, popularly known as tucolote, is one of the many species of Bromus introduced into the western United States. It is more abundant and conspicuous in California than anywhere else, and its presence in such quantity is undoubtedly a detriment to the California ranges. The feed produced by it when young, before it is headed out, is equal to that produced by any of the other weedy brome-grasses which have been introduced throughout the region, but as soon as the seed has ripened it is of very little value as feed, and in many cases it is positively detrimental to stock which happen to graze upon an area where it occurs abundantly. It is an aggressive grass and has a tendency to drive out the other annuals that compete with it. The injury done is mainly to the sheep industry. The sharp-pointed seeds work into the fleece, the feet, and even the eyes of the animals, often causing them to lose the eyesight entirely. On this account the herdsman considers it imperative that his flocks be removed from the tucolote areas of the valleys and foothills before this plant ripens its seed. The seeds also work their way into the feet of the animals, causing them to become lame and in some cases unable to travel. This is the very characteristic which enables the plant to obtain the mastery over other species. The seeds are rather sharp-pointed and slightly barbed, so that they will work their way into the ground. The sharp-pointed seeds are even more injurious to stock than the awns. (Pl. IV, fig. 2.)

No. 8262 was collected near Colton, Cal., May 8, 1906, and the sample was then practically ripe. The seed was mostly in late dough, with the leaves fast turning color, but by no means dry. The stems had turned color also, but were still full of sap. The culms were cut off 1 to 2 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8262 | 6.22 | 5.20 | 1.79 | 29.14 | 59.51 | 4.36 | 26.60 |
| One other sample [1] | ..... | 13.82 | 3.99 | 28.18 | 40.24 | 13.77 | ..... |
| Average of both | ..... | 9.51 | 2.89 | 28.66 | 49.88 | 9.06 | ..... |

[1] South Dakota Bul. 69, p. 16.

### BULBILIS DACTYLOIDES (Nutt.) Raf.

*Bulbilis dactyloides* (buffalo grass) is strictly a pasture species, distributed from the Dakotas to the Rocky Mountains and south into Mexico. Popularly, several other species are confused with this one. *Bouteloua gracilis*, especially when not in head, is very similar and frequently mistaken for it. On this account the true buffalo grass is very much overestimated in importance, because there are so many things included with it in the popular mind. Much of the credit given this species is due to the gramas, which in age especially look very much like it. On the other hand, the species is an important one throughout its range. Upon the Plains it is a very short grass, seldom getting over 2 to 4 inches high, but in southern Texas, where conditions

FIG. 1.—BOUTELOUA ROTHROCKII UNDER PROTECTION JUST BELOW THE NORTHERN FOOTHILLS OF THE SANTA RITA MOUNTAINS, ARIZ.

FIG. 2.—BOUTELOUA ARISTIDOIDES IN A FAVORABLE SEASON ON DESERT MESAS, SOUTH OF TUCSON, ARIZ.

FIG. 1.—ANDROPOGON TORREYANUS FROM SEED SOWN THE PREVIOUS SEASON ABOVE A LOW EARTHEN DAM, THROWN UP ON DESERT MESAS NEAR TUCSON, ARIZ.

FIG. 2.—NATIVE PASTURE LANDS IN THE FOOTHILLS, FRESNO COUNTY, CAL., SHOWING INTRODUCED BROME-GRASSES THAT ARE ALMOST ENTIRELY WEEDY.

eat and moisture are more favorable, it may become a foot high. In spite of this, ever, its importance upon the Plains is greater than in southern Texas, for two easons. Upon the Plains it dry-cures and furnishes excellent winter grazing. In south Texas the rainfall is more irregular, making the use of dry-grass pasture of shorter duration and much less importance. There is probably very little difference in the value of this species and *Bouteloua gracilis* for dry grazing.

No. 9315 was collected near Bellevue, Tex., June 26, 1908. The sample consisted of the staminate plant mostly and was cut close to the ground. It was a little out of blossom.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 9315 | 6.18 | 10.25 | 1.23 | 25.74 | 57.08 | 5.70 | 20.56 |
| Average of 6 others [1] | ..... | 10.55 | 2.26 | 25.22 | 54.35 | 7.62 | ..... |
| Average of all | ..... | 10.51 | 2.11 | 25.29 | 54.74 | 7.35 | ..... |

[1] Canada Central Experiment Farm Bul. 19, pp. 28–29. Colorado Bul. 12, p. 130. North Dakota Report, 1904, p. 35. South Dakota Bul. 40, p. 102. Wyoming: Bul. 76, p. 28; Bul. 87, p. 36.

### CALAMAGROSTIS CANADENSIS (Michx.) Beauv.

*Calamagrostis canadensis* is a species that inhabits moist meadows of the northern United States. It has some differences in the floral structure and on the whole is somewhat less stout than *C. langsdorfii*. It is more erect, but of approximately equal feeding value.

No. 8863 was collected at Summit, Mont., August 15, 1907. The specimen was cut before blossoming and at a height of 2 inches. Its percentage of moisture was 5.44. Other constituents (on a water-free basis) were as follows: Ash, 6.92; ether extract, 2.15; crude fiber, 34.92; nitrogen-free extract, 46.88; protein, 9.13; pentosans, 26.29.

### CALAMAGROSTIS CANADENSIS ACUMINATA Vasey.

*Calamagrostis canadensis acuminata*, the familiar purple-panicled reed-grass, has a wide range of distribution in the United States, extending from Maine to California and southward to North Carolina. It is one of the most important of the mountain grasses in moist cool situations, along streams and lakes, and in mountain meadows. It produces a fairly good quality of both hay and pasture, and its habit of growth is such as to well adapt it to being cut for hay in places where it is sufficiently abundant for this purpose.

No. 8854 was collected at Summit, Mont., August 15, 1907. The specimen was rather immature and a little under blossom. It was cut 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Calamagrostis canadensis: 14 samples [1] | ..... | 7.47 | 2.86 | 35.37 | 45.71 | 8.59 | ..... |
| Calamagrostis canadensis acuminata: | | | | | | | |
| Our sample No. 8854 | 5.98 | 6.29 | 2.70 | 35.01 | 46.82 | 9.18 | 22.96 |
| Average of 3 others [2] | ..... | 9.44 | 2.57 | 34.44 | 45.02 | 8.53 | ..... |
| Average of the 4 samples | ..... | 8.65 | 2.61 | 34.59 | 45.46 | 8.69 | ..... |
| Average of the 18 samples | ..... | 7.73 | 2.81 | 35.20 | 45.66 | 8.60 | ..... |

[1] Connecticut Report, 1879, p. 153. Iowa: Bul. 11, p. 462; Bul. 56, p. 512. Maine Report, 1888, p. 86; 1889, p. 38. Massachusetts Report, 1885, p. 97. South Dakota Bul. 40, p. 86. Wyoming: Bul. 70, p. 21; Bul. 87, p. 36.

[2] Montana Report, 1902, p. 66. Wyoming: Bul. 70, p. 22; Bul. 76, p. 35.

### CALAMAGROSTIS MONTANENSIS Scribn.

Upon the prairies of the Dakotas and eastern Montana, *Calamagrostis montanensis* IV. a plant of low stature, inhabiting high prairies entirely. It attains a maximum height of 7 or 8 inches. In favorable situations, however, it may be 1½ feet in height and can contribute very decidedly to the pasturage of the region. It is a tough, wiry species, but readily grazed by all kinds of live stock. It never forms a turf or anything approaching a complete stand. It is found scattering among species of Agropyron, Bouteloua, and Sporobolus.

No. 8818 was collected at Devils Lake, N. Dak., August 11, 1907. The specimen was a robust one, 15 to 18 inches high, and was cut close to the ground. It was overmature, but the whole plant was still in a green condition, with the exception of the lower leaves. The seeds were very badly ergoted.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8818 | 6.21 | 11.10 | 2.78 | 32.68 | 48.77 | 4.67 | 27.53 |
| One other sample [1] | ..... | 10.01 | 1.99 | 33.08 | 49.09 | 5.83 | ..... |
| Average of both | ..... | 10.55 | 2.39 | 32.88 | 48.93 | 5.25 | ..... |

[1] South Dakota Bul. 69, p. 19.

### CALAMOVILFA LONGIFOLIA (Hook.) Hack.

*Calamovilfa longifolia* (big sand-grass) is a species conspicuous in sandy regions from British Columbia to central Arizona and eastward to Indiana. It is especially at home upon sandy lands of the Plains regions and is common in many situations in northern Arizona. Its rapid spread by running rootstocks renders it of some value in holding sands and makes it quite a persistent grass for sandy regions. It is coarse and harsh; consequently, it is not relished by stock while finer feeds are available. In portions of western Nebraska and the Dakotas it forms a large part of the winter grazing, and on this account is, of course, very important. When cut in season it makes a fair quality of coarse hay.

No. 8828 was collected at Williston, N. Dak., August 11, 1907. The specimen was in late blossom and was cut at the surface of the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8828 | 6.79 | 4.80 | 2.08 | 37.64 | 50.18 | 5.30 | 25.18 |
| Average of 3 others [1] | ..... | 6.93 | 1.73 | 40.24 | 44.79 | 6.31 | ..... |
| Average of all | ..... | 6.39 | 1.82 | 39.59 | 46.14 | 6.06 | ..... |

[1] Montana Report, 1902, p. 66; South Dakota Bul. 40, p. 88; Wyoming Bul. 87, p. 38.

### CHAETOCHLOA GRIESBACHII (Fourn.) Scribn.

*Chaetochloa griesbachii* is an upright, smooth, rank, perennial native millet, distributed from Texas to Arizona. It is especially abundant upon dry, sandy situations in southern Texas. While frequent in southern Arizona, it is not of nearly as much importance. It is an important grass in Texas, furnishing a large amount of palatable grazing. Nothing is known of it as a hay grass.

No. 8384 was collected at Encinal, Tex., August 12, 1906. The sample represents the plant when fully matured, but before any of the seed had fallen. It was cut about 2 inches high. Its percentage of moisture was 10.58. Other constituents (on a water-free basis) were at follows: Ash, 11.58; ether extract, 1.70; crude fiber, 11.49; nitrogen-free extract, 65.51; protein, 9.72; pentosans, 22.05.

### CHAETOCHLOA VERTICILLATA (L.) Scribn.

*Chaetochloa verticillata* (foxtail) is a common, introduced weed in waste places and cultivated fields in many parts of the United States. It often furnishes some grazing and is sometimes included with hay.

No. 8792 was collected near Fargo, N. Dak., August 8, 1907. The sample was in late blossom and cut close to the surface of the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8792 | 7.47 | 11.98 | 2.38 | 30.40 | 41.86 | 13.38 | 24.27 |
| One other sample [1] | ..... | 13.43 | 2.32 | 35.15 | 31.91 | 17.19 | ..... |
| Average of both | ..... | 12.70 | 2.35 | 32.77 | 36.89 | 15.29 | ..... |

[1] South Dakota Bul. 40, p. 41.

### CHLORIS CUCULLATA Bisch.

*Chloris cucullata* is distinctly a sandy-land perennial, extending from Texas northeastward. It is a valuable species, producing a large quantity of root leaves of good forage value.

No. 8401 was collected near Green, Tex., August 14, 1906. The sample represents the plant in a state of overmaturity, two-thirds of the seed having shattered, the culms being nearly all dead. The root leaves, however, were all green. It was cut close to the surface of the ground. Its percentage of moisture was 6.11. Other constituents (on a water-free basis) were as follows: Ash, 12.37; ether extract, 1.89; crude fiber, 29.12; nitrogen-free extract, 45.77; protein, 10.85; pentosans, 23.81.

### CHLORIS ELEGANS H. B. K.

*Chloris elegans* is an annual plant growing 1 or 2 feet high, depending upon the situation in which it develops. It is a grass of great importance throughout the Southwest, oftentimes taking up spaces which were formerly occupied by perennials and making considerable of a volunteer crop of good pasture or hay in neglected places and along irrigated fields. It produces an abundance of fertile seed and is consequently easily established whenever the season is sufficiently moist, often upon lands which were formerly stocked with perennials that have been largely killed out by overstocking. In some situations the six-weeks grama and an annual species of Aristida occupy such areas. In other places this grass goes in. Quite frequently, in portions of the Sulphur Spring Valley in Arizona, over limited areas in favorable situations, 1½ tons of hay to the acre of this grass may be cut. It adapts itself well to cultivation and were it not for the awns upon the seeds it would be much more promising for domestication. Of course, it does not cure up as well when drought strikes it as the perennial gramas. (Pl. V, fig. 2.)

No. 8578 was collected at Green, Tex., September 24, 1906. The sample represents a very rank growth of the species in early maturity. It was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8578 | 4.22 | 13.13 | 2.18 | 27.99 | 45.34 | 11.36 | 24.59 |
| One other sample [1] | ..... | 12.73 | 1.74 | 36.39 | 39.53 | 9.61 | ..... |
| Average of both | ..... | 12.93 | 1.96 | 32.19 | 42.44 | 10.48 | ..... |

[1] Arizona Report, 1902–3, p. 349.

### COTTEA PAPPOPHOROIDES Kunth.

*Cottea pappophoroides* is a handsome species, growing in bunches of moderate size, 12 to 18 inches high, from western Texas to Arizona. It is not abundant enough to be seriously considered, except as a filler which adds an occasional palatable morsel in the general forage supply. At the present time it is much more abundant where protected by shrubbery than elsewhere, owing probably to the fact that it has been largely killed out by overgrazing.

No. 9617 was collected in the Santa Rita Mountains, Ariz., September 22, 1908. The sample was nearly mature and was cut 1½ inches high. Its percentage of moisture was 2.54. Other constituents (on a water-free basis) were as follows: Ash, 5.90; ether extract, 1.66; crude fiber, 33.21; nitrogen-free extract, 51.76; protein, 7.47; pentosans, 20.17.

### DESCHAMPSIA CAESPITOSA (L.) Beauv.

*Deschampsia caespitosa* (tussock grass) is common in the wet meadows of all the Northern States, and extends in the mountainous regions even into central California and northern Arizona. While producing tussocky formations in some of the Northeastern States, its habit is usually very different in the western moist mountain regions. There tussocks are seldom formed, the grass growing scatteringly among other species with no semblance of tussock formation. It is a handsome silvery-topped species, which enters very largely into the composition of both hay and pasture meadows. Its quality is good, and it is relished by stock.

No. 8859 was collected at Summit, Mont., August 15, 1907. The sample was in blossom and was cut 3 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8859 | 7.70 | 7.29 | 1.67 | 32.31 | 52.63 | 6.10 | 25.57 |
| Average of 9 others[1] | ..... | 7.20 | 1.56 | 36.12 | 47.31 | 7.81 | ..... |
| Average of all | ..... | 7.21 | 1.57 | 35.75 | 47.84 | 7.63 | ..... |

[1] Canada Central Experiment Farm Bul. 19, pp. 28, 32. Colorado Bul. 12, p. 72. Wyoming: Bul. 65, p. 34; Bul. 70, pp. 54, 57; Bul. 87, p. 44.

### DISTICHLIS SPICATA L. Greene.

In some portions of the country, *Distichlis spicata* (salt-grass) is considered of no value as a forage plant. However, upon large areas of alkaline soils throughout the arid West it is the principal grass and furnishes continuous pasturage to thousands of stock through the entire summer season. It is true that it is a tough, wiry species, but cattle eat it readily and apparently thrive where they have no other feed. It is also grazed in the dry condition, that is, after it is dry-cured upon the ground. What its value is in this condition, as compared with other grasses which mature in the same way upon the western prairies, no one has investigated. In spite of the fact that it is often tabooed as of no value it must be considered as one of the important native grasses of the arid West, and especially is it important, since it often inhabits soils upon which very few other plants would live. This is one of several species of grass which has been noted in recent years as secreting a gummy acid substance. This is very noticeable in some situations in the arid West, and it is so abundant as to gum the clothing of a person walking through it.

No. 8725a was collected near Tampa, Fla., June 12, 1907. The sample was in full blossom and was cut at the surface of the water in which it grew, about 3 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Western samples: | | | | | | | |
| Our sample No. 8725a | 4.27 | 7.60 | 1.43 | 31.66 | 51.71 | 7.60 | 28.12 |
| Average of 7 others[1] | ..... | 11.10 | 2.25 | 28.69 | 49.18 | 8.78 | ..... |
| Average of 8 samples | ..... | 10.66 | 2.15 | 29.06 | 49.50 | 8.63 | ..... |
| Eastern samples: | | | | | | | |
| Average of 3 samples[2] | ..... | 8.61 | 2.61 | 27.33 | 54.07 | 7.38 | ..... |
| Average of 11 eastern and western samples | ..... | 10.11 | 2.27 | 28.59 | 50.74 | 8.29 | ..... |

[1] Colorado Bul. 12, p. 105. Montana Report, 1902, p. 66. New Mexico Bul. 17, p. 36. South Dakota Bul. 40, p. 118. Washington Bul. 72, p. 15. Wyoming: Bul. 76, p. 38; Bul. 87, p. 45.
[2] Hatch Station Report, 1903, pp. 15, 87; Connecticut Report, 1889, p. 244.

### ECHINOCHLOA COLONA Link.

*Echinochloa colona* is a common weedy species introduced throughout the warmer sections of this country, but it reaches its best development in the irrigated Southwest, where it often enters in an important way into the composition of both hay and pasturage. It is a smaller plant and produces a much finer feed than the coarse barnyard grass.

No. 8567 was collected near Phoenix, Ariz., September 24, 1906. The sample represented the plant in early maturity. Its percentage of moisture was 4.16. Other constituents (on a water-free basis) were as follows: Ash, 15.33; ether extract, 1.92; crude fiber, 30.84; nitrogen-free extract, 44.08; protein, 7.83; pentosans, 20.51.

### ECHINOCHLOA CRUS-GALLI (L.) Beauv. (*Panicum crus-galli*).

*Echinochloa crus-galli* (barnyard grass, or barnyard millet) is an introduced weed common throughout the country. It furnishes considerable quite palatable grazing in waste places, and in moist, rich, loose, soils it commonly forms an important ingredient of hay. In some sections of the irrigated West, where water is used injudiciously upon newly planted alfalfa and other forage crops, this grass volunteers for several years to the detriment of the crop seeded. Often it persists to some extent continuously. The hay produced by it, if cut in season, is of very fair quality, although rather light. In exceptional cases, where conditions are proper, it has been known to make a yield of 1½ or 2 tons to the acre. (Pl. VIII, fig. 2.)

No. 8396 was collected near Green, Tex., August 14, 1906. The sample was a robust form growing in waste places. It was fully 4 feet high. The plants were considerably under maturity and were cut about 4 inches above the ground.

| Material analyzed | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8396 | 5.15 | 15.06 | 2.28 | 37.86 | 36.30 | 8.50 | 19.41 |
| Average of 29 others[1] | ..... | 9.79 | 2.28 | 30.85 | 47.49 | 9.59 | ..... |
| Average of all | ..... | 9.96 | 2.28 | 31.08 | 47.12 | 9.56 | ..... |

[1] Canada Central Experiment Farm Bul. 19, pp. 28, 29. Connecticut Report, 1879, p. 155; 1887, p. 103. Hatch Station Report, 1901, p. 35; 1903, p. 91. Iowa Bul. 56, p. 483. Kentucky: Bul. 87, p. 116; Bul. 104, p. 302. Massachusetts Report, 1884, p. 110; 1893, p. 326. New Jersey Report, 1906, p. 37. New Mexico Bul. 17, p. 36. South Dakota: Bul. 40, p. 38; Bul. 69, p. 21. Storrs Report, 1896, p. 280. U. S. Department of Agriculture Report No. 32, 1884, p. 125. Vermont Report, 1893, p. 115; 1895, p. 195; 1896–7, p. 188.

### ELYMUS CANADENSIS L.

*Elymus canadensis* is a familiar drooping, awned rye-grass which, like *E. condensatus*, has a very wide distribution and is an important forage plant, especially throughout the Plains region. It inhabits commonly the moist situations of the river valleys, where it forms an important ingredient in both hay and pasture meadows. In pastures it is relished only while young, and to make the best quality of hay it must be cut before it is woody. Its general habits are favorable for cultivation. Its seeds are abundantly produced, but the long, persistent awns would be difficult to thrash out. It is, at best, a rather hard, coarse grass for either pasture or hay.

No. 8801 was collected near Fargo, N. Dak., August 10, 1907.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8801 | 5.61 | 9.28 | 2.28 | 31.94 | 48.95 | 7.55 | 24.61 |
| Average of 10 others [1] | ..... | 8.81 | 2.22 | 34.77 | 45.97 | 8.23 | ..... |
| Average of all | ..... | 8.85 | 2.23 | 34.51 | 46.24 | 8.17 | ..... |

[1] Canada Central Experiment Farm Bul. 19, p. 32; Colorado Bul. 12, p. 58; Iowa Bul. 11, p. 467; Montana Report, 1902, p. 66; South Dakota Bul. 40, p. 158; Tennessee Bul. 3, vol. 9, p. 111; U. S. Department of Agriculture Report No. 32, 1884, p. 128; Wyoming Bul. 87, p. 48.

### ELYMUS CONDENSATUS Presl.

*Elymus condensatus* is the giant rye-grass which extends from Montana to Arizona and has a very wide altitudinal distribution. Like many other species it has two distinct habits of growth. In some situations it grows in scattered, large bunches, often 7 or 8 feet high. In other places it is scattered uniformly over the area in which it grows and frequently makes almost a complete stand. It is a very coarse, rank, smooth species, which, if used for hay, must be cut before it gets too woody. Like many other species, the estimate placed upon it varies with the locality in which it is found and with the general quality of the feed of that locality. In portions of Montana and Wyoming it is pronounced absolutely worthless, and while it is not used nearly so widely in those States as it is in the Great Basin, where extensive areas of it are cut for hay, it is, nevertheless, usually considered of very good quality. Its seed habits are very good, and it is quite probable that something could be made of it under cultivation. It ergots very badly, however, and sometimes deleterious effects upon stock are said to be produced on this account. Horses running in pastures of it are very partial to the ripe seeds. It is a common thing to see them graze off the heads and pay little attention to any other feed when the plant is mature. These heads are commonly 6 inches in length and are almost a solid mass of seeds, which, of course, are practically the same as grain. (Pl. VI, fig. 2.)

No. 8830 was collected near Havre, Mont., August 13, 1907. The sample was mature, but was all green with the exception of the head. It was harvested about 4 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8830 | 8.29 | 6.41 | 2.40 | 34.95 | 48.40 | 7.84 | 25.45 |
| Average of 4 others [1] | ..... | 8.34 | 2.91 | 38.48 | 40.31 | 9.96 | ..... |
| Average of all | ..... | 7.96 | 2.81 | 37.77 | 41.93 | 9.53 | ..... |

[1] Montana Report, 1902, p. 66. Nevada Bul. 62, p. 28. Wyoming: Bul. 70, p. 38; Bul. 87, p. 50.

### ELYMUS GLAUCUS Buckl.

*Elymus glaucus* is a species of rye-grass, common and important, especially in the edges of open mountain meadows and among shrubbery, from Michigan to California. Its habit of growth depends upon the environment. It is always a comparatively tall, coarse grass, with a fairly good leafage. In some situations it may grow scatteringly among species of Poa, Danthonia, etc. In other situations it has been seen fully 6 feet high growing in large clumps. It is seldom that it makes a pure growth. The seed is produced in abundance, and it is usually of very good quality, but the awns are a drawback. In the locality in which one of the specimens was collected it is commonly very badly attacked by smut (Tilletia). This, however, has not been observed elsewhere.

No. 8851 was collected near Summit, Mont., August 15, 1907. The seed was in the milk stage and this sample was cut 2 inches high. No. 8893 was collected near Albany, Oreg., August 25, 1907. In this sample the upper portion of the culm and many of the leaves were dead and dry. The specimens were 6 feet high and were cut 6 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8851 | 7.60 | 4.59 | 2.16 | 32.59 | 53.18 | 7.48 | 23.70 |
| Our sample No. 8893 | 4.17 | 8.47 | 1.97 | 35.22 | 50.89 | 3.45 | 21.69 |
| One other sample [1] | ..... | 9.61 | 2.79 | 36.36 | 43.62 | 7.62 | ..... |
| Average of all | ..... | 7.56 | 2.31 | 34.72 | 49.23 | 6.18 | ..... |

[1] Montana Report, 1902, p. 66.

### ELYMUS TRITICOIDES Buckl.

*Elymus triticoides* resembles in many ways the Colorado bluestem. It has underground stems and very similar seed habits and appearance, although placed by botanists in a different genus. It prefers to grow in alluvial, nonsaline edges of sinks and along river courses. It reaches its best development in the Great Basin and is of less importance in the interior valleys of California. It is an excellent hay grass, often cutting two tons of hay of good quality, which resembles that of the Colorado bluestem, but, unlike that grass, this species grows where the lands overflow once or twice in a season. There is no more promising grass for domestication, as the seed habits are excellent and both the quality and the quantity of seed produced are first class.

No. 8322 was collected near Bakersfield, Cal., May 27, 1906. The sample was in full blossom and was harvested about 2 inches high. Its percentage of moisture was 6.72. Other constituents (on a water-free basis) were as follows: Ash, 6.33; ether extract, 1.97; crude fiber, 39.55; nitrogen-free extract, 46.32; protein, 5.83; pentosans, 25.61.

### ELYMUS VIRGINICUS L.

*Elymus virginicus* is a species of wild rye, widely distributed throughout the United States. It never becomes important except in moist woodlands and in nonalkaline situations along river banks. In such situations patches of small extent are commonly found growing to the exclusion of practically everything else. In the natural condition, however, it is of secondary importance on account of the limited areas in which it grows. It produces a good leafage, its seed habits are first class, and it is well adapted to cultivation. Like nearly all of the rye-grasses, it is somewhat coarse, but not so coarse as many of the species.

No. 8794 was collected near Fargo, N. Dak., August 8, 1907. The specimen was in late blossom and was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8794[1] | 6.40 | 11.10 | 2.55 | 28.08 | 46.52 | 11.75 | 20.52 |
| Average of 8 others | | 7.15 | 2.89 | 32.37 | 48.97 | 8.62 | |
| Average of all | | 7.59 | 2.85 | 31.89 | 48.71 | 8.96 | |

[1] Canada Central Experiment Farm Bul. 19, p. 28; Connecticut Report, 1889, p. 245; Iowa Bul. 56, p. 498; Mississippi Report, 1895, p. 91; South Dakota Bul. 40, p. 157.

### ERAGROSTIS LUGENS Nees.

*Eragrostis lugens* is a tall, hard, perennial species, strictly a filler only and of secondary quality. It occurs mostly on rocky, exposed situations and produces feed that remains green quite late in the season. It is not eaten until other more palatable feed has been used.

No. 7091 (E. O. W.) was collected in the San Andreas Mountains near Las Cruces, N. Mex., October 6, 1912. Its percentage of moisture was 5.79. Other constituents (on a water-free basis) were as follows: Ash, 9.03; ether extract, 1.77; crude fiber, 32.58; nitrogen-free extract, 49.82; protein, 6.80; pentosans, 25.46.

### ERAGROSTIS SECUNDIFLORA Presl.

*Eragrostis secundiflora* is distinctively a sand-grass, being characteristic of dry, sandy areas from Florida to the Pacific coast. While extensively grazed, it is not of first quality, either in abundance or palatability. It is wiry in its nature and rejected by live stock until more palatable feeds fail.

No. 8390 was collected at Encinal, Tex., August 12, 1906. The sample was a little underripe, but contained considerable old dead leaves, although nothing was included but this year's growth. It was cut off about half an inch above the ground. Its percentage of moisture was 5.87. Other constituents (on a water-free basis) were as follows: Ash, 15.15; ether extract, 2.12; crude fiber, 30.39; nitrogen-free extract, 45.70; protein, 6.64; pentosans, 23.96.

### ERAGROSTIS SPICATA Vasey.

*Eragrostis spicata* is a tall, conspicuous grass, not abundant enough in the United States to be seriously considered as a native forage. It is a hard, rank species, not particularly relished by stock, although grazed in close pastures.

No. 8402 was collected at Green, Tex., August 14, 1906. The seed was ripe, but not fallen, and all herbage was green and fresh. It was cut 4 inches high. Its percentage of moisture was 10.30. Other constituents (on a water-free basis) were as follows: Ash, 8.77; ether extract, 1.20; crude fiber, 36.31; nitrogen-free extract, 47.44; protein, 6.28; pentosans, 23.28.

### ERIOCOMA CUSPIDATA Nutt.[1]

*Eriocoma cuspidata* (Indian millet) is a grass peculiarly adapted to the loose, sandy soils of the arid West. Although not particularly confined to such situations, it is here that it reaches its most striking development. It is distinctively a bunch grass, growing scatteringly and often in very large bunches in the most sterile of soils, often upon unstable sands. It is a highly prized and valuable species, the only objection to it being that it does not grow abundantly enough. Nowhere is it found forming anything like a ground cover. Sometimes in the edges of cultivated fields, upon railroad embankments, beside roadways, and in other situations where the ground is loosened up, its growth is very much facilitated. It is not a grass that bears grazing very well, being easily pulled up by the roots or tramped out by stock.

No. 8340 was collected near Ashfork, Ariz., May 30, 1906. This sample represents the plant in early maturity. This is true, however, of not over half of the plants,

[1] More recently written *Oryzopsis hymenoides* (R. and S.) Ricker.

FIG. 1.—HORDEUM JUBATUM, WALLA WALLA, WASH.

FIG. 2.—CHLORIS ELEGANS IN SOUTHERN ARIZONA.

FIG. 1.—MUHLENBERGIA EMERSLEYI IN THE MOUNTAINS OF SOUTHERN ARIZONA.

FIG. 2.—ELYMUS CONDENSATUS CUT FOR HAY IN NORTHERN NEVADA.

most of them being still green. They were harvested 2 to 2½ inches high, and all dead herbage was excluded. No. 8834 was collected near Havre, Mont., August 13, 1907. This sample was cut 2 inches high and consisted of large mature plants growing in a favored locality where they had received some cultivation.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8340 | 6.72 | 14.72 | 1.31 | 32.25 | 45.16 | 6.56 | 10.59 |
| Our sample No. 8834 | 5.51 | 4.47 | 2.35 | 36.52 | 52.66 | 4.00 | 29.03 |
| Average of 9 others[1] | ..... | 7.76 | 2.31 | 31.69 | 48.17 | 10.07 | ..... |
| Average of all | ..... | 8.09 | 2.22 | 32.19 | 48.30 | 9.20 | ..... |

[1] Colorado Bul. 12, p. 92. Montana Report, 1902, p. 66. Nevada: Bul. 62, p. 19; Bul. 66, p. 46. Wyoming: Bul. 65, p. 18; Bul. 76, p. 11, 40; Bul. 87, p. 50.

### FESTUCA CONFINIS Vasey (*Festuca kingii*).

*Festuca confinis* is a characteristic and valuable species of fescue of the Rocky Mountain and Sierra Nevada regions. It seldom, if ever, makes pure growths over any extended areas, but, on the other hand, grows in large bunches scattered among other species of Festuca and Agropyron. It is a rather coarse grass—indeed, one of the coarsest of the genus—of about the same texture and stature as the common cultivated English bluegrass. It is readily grazed and constitutes a valuable adjunct of the pasturage, especially of the Rocky Mountain region.

No. 8849 was collected at Summit, Mont., August 15, 1907. The sample was cut 4 inches high when the seed was in stiff dough.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8849 | 6.51 | 7.48 | 2.79 | 34.69 | 47.65 | 7.39 | 24.28 |
| Average of 4 others[1] | ..... | 6.13 | 2.80 | 36.81 | 45.91 | 8.35 | ..... |
| Average of all | ..... | 6.40 | 2.79 | 36.39 | 46.26 | 8.16 | ..... |

[1] Nevada Bul. 62, p. 14. Wyoming: Bul. 70, p. 40; Bul. 87, p. 51.

### FESTUCA MEGALURA Nutt.

*Festuca megalura*, sometimes called squirreltail fescue, is one of the characteristic introduced weedy annuals of the California region and may be found at altitudes of 6,000 or 7,000 feet in the mountains. As a filler in the native pastures it is of some importance early in the season. Like all other annual species of this group, it pulls up readily by the roots and is consequently objectionable to stock. After the seeds become mature it is not relished, and it never gets large enough to be cut for hay.

No. 8700 was collected at El Toro, Cal., April 16, 1907. The sample was in blossom and was cut off at the surface of the ground. No. 7108 (Wooton) was collected at Willows, Cal., April 8, 1913. Sometimes known here as poverty grass.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8700 | 6.53 | 6.82 | 1.33 | 35.23 | 50.34 | 6.28 | 27.79 |
| Our sample No. 7108 (E. O. W.) | 5.69 | 5.66 | 2.01 | 27.12 | 56.66 | 8.55 | 24.84 |
| Average of both | 6.11 | 6.23 | 1.67 | 31.17 | 53.50 | 7.42 | 26.32 |

### FESTUCA OVINA INGRATA Hack.

Throughout the entire Rocky Mountain region, from the San Francisco highlands in Arizona northward, there are large numbers of closely related forms of fescue, of which *Festuca ovina ingrata* may be considered economically typical. In the southernmost portion of this highland region they grow at an altitude of about 7,000 feet. Farther north they come down to the 4,000-foot level and may spread out to the adjoining bare foothills and mesas. They are characteristic grasses of bare hills and mountain sides, where they often grow to the exclusion of practically everything else. They constitute an exceedingly important group of native forage plants which will stand trampling by stock very well, although they have been killed in many sections by excessive stocking. Some very closely related forms are now in cultivation, and it would doubtless be a comparatively easy matter to domesticate some of the forms whose seed habits are just as good as those now under cultivation. They are all popularly known as sheep fescue. (Pl. VII, fig. 1.)

No. 8848 was collected at Summit, Mont., August 15, 1907. The seed of the sample was in the dough. It was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8848 | 5.11 | 4.89 | 3.13 | 34.33 | 52.12 | 5.53 | 26.68 |
| One other sample [1] | ..... | 7.72 | 1.04 | 37.30 | 49.19 | 4.75 | ..... |
| Average of both | ..... | 6.30 | 2.09 | 35.81 | 50.66 | 5.14 | ..... |

[1] Washington Bul. 82, p. 11.

### HETEROPOGON CONTORTUS Beauv.

*Heteropogon contortus*, a beard-grass with long, twisted, dark-brown to black awns, is very characteristic of the native grass flora of many situations from central Texas to Arizona and southward into Mexico. It produces a quality of feed very similar to that of some of the larger species of Andropogon. On the whole, it is probably not grazed so extensively as those species. Some sheep growers in southern Texas especially deplore its presence on account of the injury which the awns do in working into the fleece and flesh of their flocks. Anyone who has walked through a patch of this grass when mature will readily recognize the injury that it may do to sheep. However, cattle in southern Arizona graze it to the ground very frequently. In some situations, in the sandy arid mountains, it grows thick over small areas, but usually it is distinctively a bunch grass, growing only in scattered bunches among other vegetation.

No. 8397 was collected at Green, Tex., August 14, 1906. The plants were in early maturity and were cut about 3 inches above the ground. Many of the lower culm leaves were dead. No. 9589 was collected in the foothills of the Santa Rita Mountains, Ariz., September 16, 1908. The sample was duplicated on account of the viscid, sweet, gummy secretion which appeared upon the inflorescence of the plants. This is a very common phenomenon in this section.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8397 | 9.06 | 7.44 | 1.34 | 34.47 | 51.93 | 4.82 | 27.46 |
| Our sample No. 9589 | 1.73 | 4.58 | 1.54 | 32.10 | 57.65 | 4.13 | 24.00 |
| Average of both | 5.40 | 6.01 | 1.44 | 33.28 | 54.79 | 4.48 | 25.73 |

### HILARIA CENCHROIDES H. B. K.

*Hilaria cenchroides* (curly mesquite) is one of the characteristic grasses of the Southwestern United States and of Mexico. In habit it simulates very closely the buffalo grass (*Bulbilis dactyloides*), spreading by slender, creeping rootstocks. It never grows large enough to be cut for hay, but is a very important pasture grass in many situations from Texas to Arizona. It seldom attains a height of 12 inches; more often it is only about 6 inches tall. It produces, however, an abundance of root leaves and grows whenever the rainfall is sufficient. In southern Arizona the species grows only during the rainy season of summer, maturing in late September. In many situations west of central Texas there are large areas where this species forms the main pasturage.

No. 9200 was collected at San Antonio, Tex., April 18, 1908. The sample was mature, but still perfectly green. It was cut close to the ground; hence it included the root leaves, creeping stocks, and upright stems, as well as a few old dead leaves. Its percentage of moisture was 8.16. Other constituents (on a water-free basis) were as follows: Ash, 9.37; ether extract, 2.09; crude fiber, 24.51; nitrogen-free extract, 55.26; protein, 8.77; pentosans, 21.13.

### HOLCUS LANATUS L.[1]

*Holcus lanatus* (velvet grass), like many other aggressive species, has many warm friends, and it has bitter enemies. It is widely introduced throughout the United States as far south as the Carolinas. While commonly considered to produce a feed of low grade, many ranchers in the Pacific Northwest, the only place in which it is abundant, find it a very valuable grass. It inhabits moist meadows and furnishes both hay and pasturage of medium quality.

No. 8891 was collected near Hood River, Oreg., August 23, 1907. The sample was mature, one-half of the culm dry, but the leaves were all green. It was cut 3 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8891 | 4.89 | 12.24 | 2.83 | 27.42 | 51.47 | 6.04 | 21.63 |
| Average of 8 others [2] | ..... | 9.42 | 2.97 | 29.68 | 47.98 | 9.95 | ..... |
| Average of all | ..... | 9.73 | 2.95 | 29.43 | 48.38 | 9.51 | ..... |

[1] More recently written *Notholcus lanatus* (L.) Nash.

[2] Canada Central Experiment Farm Bul. 19, p. 28; Kentucky Report, 1902, p. 302; Louisiana Bul. 19, series 2, p. 553; Mississippi Report, 1895, p. 91; U. S. Department of Agriculture Report No. 32, 1884, pp. 127, 136; Virginia Bul. 180, p. 96; West Virginia Bul. 23, p. 36.

### HOMALACENCHRUS ORYZOIDES (L.) Poll.

*Homalacenchrus oryzoides*, the cut-grass with which every boy is disagreeably acquainted, is commonly pastured by cattle along streams and fresh-water lakes throughout its range. It never grows abundantly enough or pure enough to enter appreciably into the composition of hay.

No. 8793 was collected at Fargo, N. Dak., August 8, 1907. The sample was 2 to 2½ feet high, but had not quite headed out. It was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8793 | 10.24 | 17.35 | 2.71 | 32.17 | 37.04 | 10.73 | 21.11 |
| Average of 4 others [1] | ..... | 13.73 | 2.23 | 29.90 | 44.87 | 9.27 | ..... |
| Average of all | ..... | 14.45 | 2.33 | 30.35 | 43.31 | 9.56 | ..... |

[1] Kentucky: Bul. 87, p. 116; Bul. 104, p. 302. Mississippi Report, 1888, p. 33. South Dakota Bul. 40, p. 52.

### HORDEUM GUSSONEANUM Parl. (*Hordeum maritimum* With.).

*Hordeum gussoneanum*, like *H. jubatum*, is an introduced weed, but it inhabits lower, moister situations and is not so abundant and widely distributed in this country. The situations in which it is found are mostly low, moist places where water stands for a portion of the year, thus killing out other plants. Its feeding value is approximately the same as *H. jubatum*.

No. 8319 was collected near Stockton, Cal., May 26, 1906. The sample represents the plant in the milk state. It was cut close to the ground. Its percentage of moisture was 6.35. Other constituents (on a water-free basis) were as follows: Ash, 11.77 ether extract, 1.96; crude fiber, 33.02; nitrogen-free extract, 44.65; protein, 8.60; pentosans, 26.19.

### HORDEUM JUBATUM L.

*Hordeum jubatum* is the common squirreltail grass which inhabits saline, moist situations as far west as the valley of the Little Colorado in Arizona. West of this it gives place to *H. murinum*, or wall barley, discussed elsewhere. The quality of the feed produced by *H. jubatum* is about the same as that produced by the other species and approximately the same remarks apply to it. It is often a troublesome weed in meadows in situations best adapted for its development. (Pl. V, fig.1.)

No. 8356 was collected in cultivated irrigated fields and meadows on the bottoms along the Little Colorado River near Winslow, Ariz., June 1, 1906. Here this grass appears to gain a foothold in the lower, poorer tilled portions of alfalfa fields and gradually spreads from here to occupy more and more of the field. The sample was in early blossom and was cut 1½ inches high. No. 8799 was collected near Fargo, N. Dak., August 10, 1907. The sample was somewhat rusty and the seed nearly ripe. It was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8356 | 7.24 | 15.08 | 1.96 | 28.23 | 47.26 | 7.47 | 12.60 |
| Our sample No. 8799 | 5.21 | 12.11 | 2.67 | 32.49 | 42.77 | 9.96 | 25.58 |
| Average of 13 others [1] | ..... | 10.41 | 3.56 | 32.13 | 41.99 | 11.91 | ..... |
| Average of all | ..... | 10.83 | 3.39 | 31.90 | 42.40 | 11.48 | ..... |

[1] Colorado Bul. 12, p. 118. Iowa: Bul. 30, p. 320; Bul. 56, p. 533. Montana Report, 1902, p. 66. South Dakota Bul. 40, p. 156. Wyoming: Bul. 65, p. 25; Bul. 87, p. 56.

### HORDEUM MURINUM L.

*Hordeum murinum* is a very persistent and pernicious annual weed, introduced from the Mediterranean region. It grows in the most favorable places on uplands, as well as lowlands, throughout California and extends eastward into Arizona. In California it has found congenial conditions upon uncultivated lands. In Arizona, however, where conditions are less favorable, it inhabits cultivated and irrigated areas, being especially troublesome in alfalfa fields. On this account, it is a common practice of the renter to require that the first crop of alfalfa be cut, in order to get rid of as much as possible of this weed. While it may be classed among the weeds, it nevertheless furnishes a large amount of quite valuable forage. It is readily grazed up to the time that it heads out; after that time the awns are very annoying to stock. When it occurs in hay, these work in between the teeth of horses and cattle and often cause considerable injury. Reports show that there is a way to feed it successfully, however. Some have chopped it up with a hay cutter and moistened it for 12 or 24 hours, when the awns are so softened that they produce no deleterious effects. Pasture meadows having very much of this grass in them should be mowed about the time that it begins to head out, thus getting rid of the awns and sharp fruit.

No. 8300 was collected near Banning, Cal., May 15, 1906. The sample was in early maturity and was harvested 1 inch above the ground. Its percentage of moisture was 6.70. Other constituents (on a water-free basis) were as follows: Ash, 6.86; ether extract, 2; crude fiber, 35.99; nitrogen-free extract, 47.72; protein, 7.43; pentosans, 26.84.

### KOELERIA CRISTATA (L.) Pres.

*Koeleria cristata* (June-grass) furnishes very important grazing throughout the Plains regions; it extends from British Columbia to Arizona and from the Alleghanies to the Sierra Nevadas, according to the common acceptance of the species. It is very doubtful, however, whether the prairie forms of the Dakotas and Montana should be considered under the same name as the ones which grow in the mountains of the Southwest. Upon the Plains, from the Dakotas to the Panhandle of Texas, it grows in scattering bunches among other prairie grasses, forming often one-fourth to one-eighth of the vegetation, mostly upon the rolling hillsides. In the mountains of the Southwest it grows in scattering bunches, mostly in thin-growing scattering timber, and matures its seeds in late September and early October; upon the prairies of the Dakotas its seed ripens in early June. Its abundant root leaves, 5 to 10 or 12 inches in length, and its early maturity upon the prairies are characteristics which render it a valuable pasture grass. As a hay plant it is of only medium quality, because the culms are mostly bare and many of the root leaves are lost in the cutting.

No. 7120 (Wooton) was collected at Moorpark, Cal., April 18, 1913. The specimen was just forming the panicle. No. 8839 was collected at Havre, Mont., August 13, 1907. This sample was cut close to the ground and represents the composition of the plant when the culms are well dried up and only about half of the root leaves are green.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7120 (E. O. W.). | 4.96 | 9.26 | 2.46 | 34.45 | 44.69 | 9.14 | 26.80 |
| Our sample No. 8839 | 4.47 | 9.65 | 2.99 | 34.32 | 48.56 | 4.48 | 24.91 |
| Average of 8 others [1] | ..... | 7.18 | 3.03 | 33.90 | 46.77 | 9.12 | ..... |
| Average of all | ..... | 7.45 | 3.03 | 33.94 | 46.98 | 8.60 | ..... |

[1] Canada Central Experiment Farm Bul. 19, p. 28. Colorado Bul. 12, p. 110. South Dakota Bul. 40, p. 116. Wyoming: Bul. 70, p. 44; Bul. 76, p. 48.

### LAMARCKIA AUREA (Dalech) Moench.[1]

*Lamarckia aurea* (golden-top grass) is a handsome species that is native to the Mediterranean region of the Old World. It is widely introduced in southern California where, together with wild oats, the brome-grasses, and other introduced weedy annuals, it furnishes a large amount of grazing. It can not be considered a first-quality grass, because, in the first place, it is an annual and, in the second place, it is low in stature, seldom becoming a foot in height. It is, however, probably fully as valuable as many of the brome-grasses, but is not to be compared with wild oats.

No. 8314 was collected at Garvanza, Cal., May 19, 1906. The sample was at nearly full maturity and was pulled up, the roots being then cut off close. Its percentage of moisture was 7.40. Other constituents (on a water-free basis) were as follows: Ash, 25.79; ether extract, 3.17; crude fiber, 29.90; nitrogen-free extract, 36.21; protein, 4.93; pentosans, 23.94.

[1] More recently written *Achyrodes aureum* (L.) Kunze.

### LEPTOCHLOA DUBIA (H. B. K.) Nees.

*Leptochloa dubia* is a species said to be distributed within the limits of the United States from Florida to Arizona, and it extends southward far into Mexico. In the Southwest, where it reaches the greatest perfection, it inhabits the higher valleys and lower mountain areas, making a very striking and favorable growth, often 3 feet in height. It never produces a perfect stand, but grows scatteringly among the gramas, muhlenbergias, and similar species. Its seed habits are good, and it is considered a promising species for cultivation. It is rather coarse, but the leafage and habit are both good, and really it is but little coarser than timothy or English bluegrass.

No. 8950 was collected in the Santa Rita Mountains, Ariz., September 25, 1907. The specimen was nearly mature. It was cut 3 inches high. Its percentage of moisture was 6.57. Other constituents (on a water-free basis) were as follows: Ash, 10.23; ether extract, 1.74; crude fiber, 33.36; nitrogen-free extract, 47.98; protein, 6.69; pentosans, 22.62.

### LEPTOCHLOA FILIFORMIS (Lam.) Beauv. (*Leptochloa mucronata*).

*Leptochloa filiformis* is a common and conspicuous species in the edges of streams, ponds, and neglected irrigating ditches throughout the Southwest. It is especially partial to alkaline soils; and, in some situations in the San Joaquin Valley of California, upon lands which have been abandoned for ordinary crops on account of the accumulation of soluble salts in the surface soils, so long as the ground is irrigated and not invaded by Bermuda grass and other perennials which choke it out, this grass is known to yield a large amount of forage. It seems to make a fair quality of feed, but its annual habit and its being adapted to peculiar special conditions make it of only secondary importance.

No. 8577 was collected near Tempe, Ariz., September 24, 1906. The specimen was in early maturity and was harvested close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8577 | 2.26 | 14.79 | 1.88 | 22.36 | 52.27 | 8.70 | 15.43 |
| Average of 4 others[1] | ..... | 10.95 | 2.28 | 30.94 | 43.32 | 12.51 | ..... |
| Average of all | ..... | 11.72 | 2.20 | 29.22 | 45.11 | 11.75 | ..... |

[1] Connecticut Report, 1879, p. 155; Mississippi Report, 1895, p. 91; U. S. Department of Agriculture Report No. 32, 1884, p. 127.

### LIMNODEA ARKANSANA (Nutt.) Dewey.

*Limnodea arkansana* ranges from Texas to Florida and enters largely into the composition of dry upland pastures in southern Texas. It appears to be a valuable species, which when in the vegetative condition is grazed by stock as readily as the gramas. When dried, however, it seems to lose substance. In some seasons in southern Texas (and this was true especially in 1908) it grows large enough to be cut for hay in ungrazed upland pastures.

No. 9204 was collected at San Antonio, Tex., April 20, 1908. The specimen was in late blossom and was cut 2 inches above the ground. Its percentage of moisture was 8.47. Other constituents (on a water-free basis) were as follows: Ash, 9.56; ether extract, 2.18; crude fiber, 34.48; nitrogen-free extract, 46.10; protein, 7.68; pentosans, 20.86.

### LYCURUS PHLEOIDES H. B. K.

*Lycurus phleoides* is a species of the arid Southwest which has been popularly called "Texan timothy," and it really does have a faint superficial resemblance to timothy, the cultivated hay plant. It is a common species from Colorado to Texas and westward to Arizona. In southern Arizona, where we are most familiar with it, this grass

inhabits gravelly ridges of the foothills region midway between the desert mesas and the moister mountains. Nowhere does it form a complete ground cover, but it is commonly found in bunches scattered among other grasses and is consequently not a grass of the first importance, although readily eaten by stock in both dry field-cured and green conditions.

No. 9518 was collected near Prescott, Ariz., August 31, 1908. The sample was in late blossom and was harvested by being cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 9518 | 7.07 | 7.25 | 2.00 | 34.08 | 50.06 | 6.61 | 19.74 |
| One other sample[1] | ..... | 7.55 | 2.28 | 34.16 | 49.80 | 6.21 | ..... |
| Average of both | ..... | 7.40 | 2.14 | 34.12 | 49.93 | 6.41 | ..... |

[1] New Mexico Bul. 17, p. 37.

### MELICA BULBOSA Geyer.

*Melica bulbosa* (melic grass) is a Pacific coast species of importance only as a filler. It is a tall, coarse species with bare, hard culms, growing scatteringly among other grasses and shrubbery, but it is always grazed where opportunity offers. This is one of the native bunch grasses which have been almost exterminated. The fact that it is to be found rather abundantly along the railroad right of way in some places indicates that it might come back on much of the range country if given a chance.

No. 7106 (E. O. W.) was collected at Red Bluff, Cal., April 6, 1913. Its percentage of moisture was 4.65. Other constituents (on a water-free basis) were as follows: Ash, 8.76; ether extract, 2.94; crude fiber, 30.36; nitrogen-free extract, 45.16; protein, 12.78; pentosans, 24.74.

### MELICA IMPERFECTA Trin.

*Melica imperfecta* is one of the original perennial bunch grasses of California which was no doubt much more abundant formerly than it is now. At present it is found mostly in the protection of shrubbery. It is relished by stock and is therefore always closely grazed.

No. 7118 (E. O. W.) was collected at Moorpark, Cal., April 18, 1913. Its percentage of moisture was 4.93. Other constituents (on a water-free basis) were as follows: Ash, 8.70; ether extract, 1.94; crude fiber, 36.95; nitrogen-free extract, 43.60; protein, 8.81; pentosans, 27.

### MUHLENBERGIA ARENICOLA Buckl.

*Muhlenbergia arenicola* is strictly a sandy-land species, at times very conspicuous because it follows up other species which have been grazed out. Although at times abundant over considerable areas, it is not relished by stock.

No. 7084 (E. O. W.) was collected on sand hills northeast of Las Cruces, N. Mex., October 3, 1912. Its percentage of moisture was 4.52. Other constituents (on a water-free basis) were as follows: Ash, 9.03; ether extract, 2.05; crude fiber, 33.80; nitrogen-free extract, 48.31; protein, 6.81; pentosans, 26.58.

### MUHLENBERGIA EMERSLEYI Vasey.

*Muhlenbergia emersleyi* is a typical Mexican species which extends into the mountains of the southwestern United States, forming a coarse, harsh forage resorted to by cattle when other more palatable feeds fail. It grows in large bunches, often 2½ feet high and having a spread of similar dimensions. In southern Arizona it invariably inhabits the oak belt in the mountains, from the open, gently sloping, upper mesas to an altitude of approximately 5,000 feet. It never gets down to the desert mesas. It is a very handsome grass and, were it possible to cultivate it, might make a valuable

ornamental. The first number listed below is considered to be typical of the species, However, the group has not been carefully worked out. Segregations in the future may separate the second number as a distinct species from the first. (Pl. VI, fig. 1.)

No. 8952 was collected in the upper foothills of the Santa Rita Mountains, Ariz., September 25, 1907. The sample was in late blossom and was cut 3 inches high; hence it included all of the material that could possibly be eaten by stock. Indeed, the stubble of the sample collected would represent conditions under very close grazing. No. 9600 was collected in the northern foothills of the Santa Rita Mountains, September 18, 1908. The sample was in early blossom and prepared about the same as the previous number.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8952 | 5.72 | 7.19 | 1.79 | 30.72 | 55.46 | 4.84 | 25.95 |
| Our sample No. 9600 | 3.01 | 9.05 | 1.05 | 41.34 | 43.56 | 5.00 | 24.92 |
| Average of both | 4.37 | 8.12 | 1.42 | 36.03 | 49.51 | 4.92 | 25.43 |

### MUHLENBERGIA GRACILIMA Torr.

*Muhlenbergia gracilima* is a dry-land species extending from western Texas to California and northward to Colorado and Nevada. It is a conspicuous plant upon the semisodded mesas and foothills of the region. It occupies neither the moister nor the drier situations, but rather the medium lands on the dividing line between sodded and unsodded conditions. Where it occurs it usually forms a mat of tangled stems and leaves upon the surface of the ground, thus producing a semblance at least of a turf. While of a great deal of importance on account of its wide distribution and abundance, it is not a first-quality grass. It seldom gets over 3 inches high before the bare culms stretch up a foot or less beyond this. The culms invariably break off easily and are seldom grazed by live stock. Associated with the species are usually found buffalo grass, the gramas, and the bluestems, all of which are more palatable to stock. In spite of this, however, the species is grazed to extermination in many situations and is more or less relished by stock when other feeds become scarce.

No. 9515 was collected near Prescott, Ariz., August 30, 1908. The sample was in early fruit and was cut close to the ground, some old dry leaves being unavoidably included. Its percentage of moisture was 8.57. Other constituents (on a water-free basis) were as follows: Ash, 12.36; ether extract, 2.53; crude fiber, 31.03; nitrogen-free extract, 46.31; protein, 7.77; pentosans, 18.41.

### MUHLENBERGIA NEOMEXICANA Vasey.

*Muhlenbergia neomexicana* is a low, tufted, hard, wiry perennial, at times of considerable value on account of its abundance, but it is a filler only. In limited localities in the Southwest, however, it is abundant enough to give character to the pasturage. It usually occurs on rocky exposed ridges in the mountains of southern Arizona, New Mexico, and western Texas in the woodlands or open coniferous forests up to about 7,000 feet elevation.

No. 7094 (E. O. W.) was collected in the San Andreas Mountains near Las Cruces, N. Mex., October 6, 1912. Its percentage of moisture was 5.61. Other constituents (on a water-free basis) were as follows: Ash, 5.65; ether extract, 2.39; crude fiber, 37.55; nitrogen-free extract, 48.28; protein, 6.13; pentosans, 26.90.

### MUHLENBERGIA PORTERI Scribn.

*Muhlenbergia porteri* (black grama) although of less importance by far than many other southwestern grasses, is in many ways most interesting. At the same time it is so important that it never should be omitted from a list of forage grasses of the region from western Texas to California and northward to Colorado and Utah. In the Santa Rita Mountains of southern Arizona it always grows in tangled masses in bunches of

FIG. 1.—FESTUCA ARIZONICA IN OPEN PARKS IN THE WHITE MOUNTAINS OF ARIZONA.

FIG. 2.—A GOOD MOUNTAIN PASTURE IN SOUTHERN ARIZONA, CONSISTING OF SPECIES OF BOUTELOUA, ANDROPOGON, LYCURUS, ETC.

FIG. 1.—SPOROBOLUS WRIGHTII ON THE VALLEY FLOOR, ERODED INTO TUSSOCKS, SOUTHWESTERN ARIZONA.

FIG. 2.—ECHINOCHLOA CRUS-GALLI, A VOLUNTEER CROP, NEAR WESTFALL, OREG.

shrubbery, cat's-claw, hackberry, mesquite, etc., where it remains unmolested by stock as long as other feeds are available with less annoyance from the shrubby spiny protectors. In the Organ Mountains of New Mexico it grows in clumps of shrubbery also, but more often in the open.

Eight or nine years ago, when a large tract of range land was fenced by the United States Department of Agriculture in the northwestern foothills of the Santa Rita Mountains in southern Arizona, this grass was nowhere conspicuous. It was invariably closely cropped except where it was impossible for stock to get at it. Now tangled clumps 3 feet high and 6 or 8 feet in diameter are not uncommon, generally produced since the field was inclosed. In times past it was a common thing for the Mexican people to cut large quantities of this grass in the upper foothills along the Mexican border, packing it to villages and mining camps on burros.

The species is in reality a shrub. It makes a growth approximately equal each year to some of the other grasses, but instead of dying to the ground each winter, only the leaves, flowers, and smaller branches die, the older hardened culms remaining alive. In time, therefore, a tangled mass, such as that described above, representing portions of the growths of several years, is formed. Although several years old the stems are not so woody as one might expect. Indeed, they are not so woody but that cattle will eat them even if they are 3 or 4 years old. It can be easily imagined how fond stock are of these green clumps in winter when other vegetation is dead and dried up.

No. 8940 was collected in the foothills of the Santa Rita Mountains, Ariz., September 23, 1907. The sample represents the nearly mature plant of the current year's development. This season's growth, about 10 to 12 inches, was taken with very little of the older culms. Its percentage of moisture was 5.76. Other constituents (on a water-free basis) were as follows: Ash, 6.53; ether extract, 2.28; crude fiber, 35.63; nitrogen-free extract, 49.59; protein, 5.97; pentosans, 26.25.

### MUHLENBERGIA WRIGHTII Vasey.

*Muhlenbergia wrightii* grows in large bunches upon the second bottoms of mountain streams and dry washes of northern Arizona. Its affinities are with *Sporobolus brevifolius*. The leaves are a little more abundant, and the plant throughout is less wiry than that species. In this region it adds considerable to the pasturage, since it is resorted to by stock and readily grazed when more palatable feeds fail.

No. 9554 was collected at Prescott, Ariz., September 7, 1908. Its percentage of moisture was 6.58. Other constituents (on a water-free basis) were as follows: Ash, 8.39; ether extract, 1.91; crude fiber, 32.14; nitrogen-free extract, 50.50; protein, 7.06; pentosans, 27.39.

### PANICULARIA GRANDIS (Wats.) Nash.

*Panicularia grandis* is a soft, spongy stemmed, sprangle-topped reed-grass, inhabiting low, moist, alluvial grounds in the edges of swamps and streams from Labrador to California. It never grows abundant enough to be of any great economic importance, but furnishes very acceptable grazing wherever it occurs. Usually it is more or less pure in small patches, but it may also be found scattered among sedges, rushes, and other water-loving plants.

No. 8795 was collected at Fargo, N. Dak., August 8, 1907. The sample was cut close to the ground when in late fruit.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8795 | 7.19 | 17.31 | 2.22 | 26.71 | 43.38 | 10.38 | 17.79 |
| Average of 5 others [1] | ..... | 9.48 | 1.74 | 33.39 | 45.42 | 9.97 | ..... |
| Average of all | ..... | 10.78 | 1.82 | 32.28 | 45.08 | 10.04 | ..... |

[1] South Dakota Bul. 40, p. 134. Wyoming: Bul. 70, p. 35; Bul. 87, p. 64.

### PANICULARIA PAUCIFLORA (Presl.) Kuntze.

*Panicularia pauciflora* is a soft, water-loving species of smaller stature than *P. grandis*. It also never becomes abundant, but commonly makes almost pure stands in the edges of fresh-water ponds, streams, and marshes, especially in the high altitudes of the Rocky Mountain regions. The areas are all small, however, being seldom over a few rods in extent, and usually they are much smaller in area than this. What there is of it is readily grazed by all classes of live stock.

No. 8868 was collected at Summit, Mont., August 15, 1907. The sample was cut close to the ground when the seed was in early maturity. Its percentage of moisture was 6.34. Other constituents (on a water-free basis) were as follows: Ash, 10.01; ether extract, 5.27; crude fiber, 25; nitrogen-free extract, 46.23; protein, 13.49; pentosans, 20.37.

### PANICUM FASCICULATUM Swartz.

The main economic interest in *Panicum fasciculatum* is derived from the fact that it often produces a heavy aftermath of good quality in grain fields or in waste places in our irrigated Southwest.

No. 8568 was collected near Phoenix, Ariz., September 24, 1906. The sample represents the plant when the seeds are fully mature. Its percentage of moisture was 4.68. Other constituents (on a water-free basis) were as follows: Ash, 15.19; ether extract, 2.01; crude fiber, 25.91; nitrogen-free extract, 46.99; protein, 9.90; pentosans, 19.44.

### PANICUM FILIPES Scribn.

*Panicum filipes* resembles more closely than anything else a somewhat dwarf-leaved form of switch-grass (*P. virgatum*). It grows abundantly in dry situations in southern Texas and forms a valuable part of the pasturage, growing in scattered bunches. It can not be considered of much consequence in native hays, but its delicate panicle, abundant leafage, and rather small culms render it of considerable importance as a pasture grass.

No. 8403 was collected near Green, Tex., August 14, 1906. The sample represents the plant with the seed fully mature and half of the leaves dead and dry. It was harvested about 2 inches high. Its percentage of moisture was 5.44. Other constituents (on a water-free basis) were as follows: Ash, 9.66; ether extract, 1.89; crude fiber, 32.57; nitrogen-free extract, 50; protein, 5.88; pentosans, 26.09.

### PANICUM HALLII Vasey.

*Panicum hallii* (panic-grass) is of a great deal of importance as a filler on the open mesas and rocky hills, as well as in poorly cultivated fields from Texas to Arizona. It is a species of secondary quality.

No. 7087 (E. O. W.) was collected on the mesas near Las Cruces, N. Mex., October 4, 1912. Its percentage of moisture was 3.42. Other constituents (on a water-free basis) were as follows: Ash, 10.77; ether extract, 1.56; crude fiber, 31.93; nitrogen-free extract, 50.29; protein, 5.45; pentosans, 25.05.

### PANICUM OBTUSUM H. B. K.

*Panicum obtusum* is a common and familiar grass, sometimes known as vine mesquite, extending from Colorado to the Gulf of Mexico and westward through Arizona. It usually inhabits waste places, alluvial bottoms, and other moist situations, commonly to the exclusion of everything else wherever it gains a good foothold. Its ability to develop by long overground stems, which root at every joint, gives it a great advantage in soils which are comparatively loose. It seldom is in condition to be cut for hay, but in a few situations it has been seen making a growth which would yield, if cut with the mower, fully 1 ton to the acre. Near Seligman, Ariz., during the autumn of 1908 there were considerable areas of it, in one place 5 or 6 acres which would make 1 to $1\frac{1}{4}$ tons to the acre. This situation, however, was an exceptional one. A large quantity of earth had been washed down from a dam which broke in the early summer, depositing from 1 to 6 inches of loose earth over the entire area. It is in situations where the soil is of this nature that the plant shows to best advantage. It makes but

a fair quality of hay and is not usually grazed where other palatable feeds occur. (Pl. IX, fig. 1.)

No. 9551 was collected near Seligman, Ariz., September 6, 1908. The sample was in full blossom and was harvested close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 9551 | 6.43 | 9.44 | 4.45 | 35.27 | 39.32 | 11.52 | 21.21 |
| Average of 3 others [1] | | 9.49 | 2.38 | 32.74 | 47.45 | 7.94 | |
| Average of all | | 9.48 | 2.90 | 33.37 | 45.42 | 8.83 | |

[1] Connecticut Report, 1879, p. 155; New Mexico Bul. 17, p. 37; U. S. Department of Agriculture Report No. 32, 1884, p. 125.

### PANICUM VIRGATUM L.

The common switch-grass (*Panicum virgatum*) is familiar and conspicuous on account of its large stature. It extends from the East to the Middle West. In the Plains region it mostly inhabits the moist situations. It seldom forms a pure growth over any extended areas, but is commonly found in large bunches several feet across and 3 to 4 feet high. It is a coarse, rank, smooth species, with good seed habits, and it adapts itself to cultivation very well. It has been considered by some as rather promising for domestication.

No. 9337 was collected near Henrietta, Tex., July 1, 1908. The sample was just beginning to head out and was cut 4 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 9337 | 5.95 | 5.64 | 2.05 | 37.20 | 50.44 | 4.67 | 21.63 |
| Average of 16 others [1] | | 6.30 | 2.26 | 33.28 | 51.60 | 6.56 | |
| Average of all | | 6.26 | 2.25 | 33.52 | 51.52 | 6.45 | |

[1] Canada Central Experiment Farm Bul. 19, p. 28. Colorado Bul. 12, p. 30. Connecticut Report, 1879, p. 155; 1887, p. 103. Iowa Bul. 56, p. 480. Mississippi Report, 1895, p. 92. North Carolina Bul. 90b, p. 4. South Dakota Bul. 40, p. 36. Tennessee Bul. 3, vol. 9, p. 112. U. S. Department of Agriculture Report No. 32, 1884, p. 125. West Virginia Report, 1891, p. 35. Wyoming Bul. 87, p. 68.

### PAPPOPHORUM APERTUM Munro.

*Pappophorum apertum* is a perennial bunch grass with a long, white, spikelike head, common in the moister situations from western Texas to Arizona. It is never very abundant and almost never forms a continuous growth. On the other hand, it is found scatteringly among other species, thus simply adding to the sum total of the feed and not imparting any distinctive character to it.

No. 8393 was collected near Green, Tex., August 14, 1906. The sample was overripe, the seed having very largely dropped off, and there were some dry leaves at the base. It was harvested about 3 inches above the ground. Its percentage of moisture was 8.29. Other constituents (on a water-free basis) were as follows: Ash, 8.85; ether extract, 1.68; crude fiber, 34.87; nitrogen-free extract, 48.26; protein, 6.34; pentosans, 24.11.

### PASPALUM DILATATUM Poir.

*Paspalum dilatatum* is a coarse, wide-leaved, perennial species, widely distributed from Virginia to Florida and westward to the arid portion of western Texas. It is partial to low, moist grounds and produces in such situations a valuable part of the

pasturage. Like other species of the genus, however, the forage produced is of secondary quality.

No. 8726 was collected near Tampa, Fla., June 12, 1907. The sample was in full-blossom and was cut at the surface of the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8726 | 7.07 | 7.49 | 2.42 | 35.72 | 45.60 | 8.77 | 22.83 |
| Average of 4 others [1] | ..... | 10.40 | 2.77 | 30.82 | 48.11 | 7.90 | ..... |
| Average of all | ..... | 9.82 | 2.70 | 31.80 | 47.61 | 8.07 | ..... |

[1] Louisiana Bul. 114, p. 23; Mississippi Report, 1895, p. 92; Texas Report, 1888, p. 30.

### PASPALUM STRAMINEUM Nash.

*Paspalum stramineum* is a low, ascending, spreading species, of a great deal of importance in some localities upon sandy lands. It has some value as a sand binder and furnishes very early feed. It is found upon loose sands in circumscribed areas from Nebraska to New Mexico and southward.

No. 7078 (E. O. W.) was collected in the San Andreas Mountains, N. Mex., September 23, 1912. Its percentage of moisture was 4.72. Other constituents (on a water-free basis) were as follows: Ash, 7.17; ether extract, 1.37; crude fiber, 34.31; nitrogen-free extract, 52.73; protein, 4.42; pentosans, 24.83.

### PHALARIS ARUNDINACEA L.

Reed canary grass (*Phalaris arundinacea*) is a common, stout, rank, smooth, leafy, perennial grass, widely distributed from Nova Scotia to Tennessee and westward to California. It inhabits marshes and low, wet meadows in general, often growing in a foot of water for a considerable period. It is seldom that it forms pure growths, usually being found scatteringly among other grasses and sedges in river bottoms and other moist situations, where it is a valuable adjunct to the native hay and pasture crops.

It adapts itself well to cultivation and, although growing in moist situations naturally, develops well on dry cultivated uplands. The serious objection to it as a cultivated plant is its seed habits. It produces an abundance of fertile seeds, and they are free from any wool, lint, or chaff which would make them objectionable in gathering, but they are very loosely attached to the plant and drop off immediately when ripe. Maturing as they do from the top downward, the upper seeds are often shed before the lower ones are fit to harvest.

No. 8323 was collected at Bakersville, Cal., May 27, 1906, when the seed was mature but the entire plant was still green. It was cut 3 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8323 | 6.05 | 8.04 | 1.41 | 31.09 | 55.73 | 3.73 | 20.39 |
| Average of 17 others [1] | ..... | 8.34 | 3.06 | 30.20 | 47.67 | 10.73 | ..... |
| Average of all | ..... | 8.32 | 2.97 | 30.25 | 48.12 | 10.34 | ..... |

[1] Canada Central Experiment Farm Bul. 19, pp. 28, 32. Colorado Bul. 12, p. 88. Connecticut Report, 1879, p. 153. Iowa Bul. 11, p. 457. Kentucky Bul. 87, p. 116; Report, 1902, p. 302. Montana Report, 1902, p. 66. North Carolina Bul. 90b, p. 4. New York Report, 1886, p. 342; 1887, p. 407. South Dakota Bul. 40, p. 54. Vermont Report, 1889, p. 86. Washington Bul. 72, p. 15.

### PHLEUM ALPINUM L.

Mountain timothy (*Phleum alpinum*), native to both hemispheres and to both the North American and South American continents, resembles very closely the cultivated timothy. It can be easily distinguished, however, by its shorter, stouter heads and smaller stature throughout. It usually inhabits the drier portions of moist mountain meadows. Growing scatteringly among other grasses, it can not be considered as a forage plant of prime importance in these situations, because it is never sufficiently abundant to impart its own character to the vegetation. So far as it goes, however, it is probably as valuable as the common cultivated timothy, which is widely introduced throughout the mountain ranges of this country, furnishing in many places vastly more feed than this smaller native.

No. 8845 was collected at Summit, Mont., August 15, 1907, when the upper florets were in early maturity. It was cut 1 inch above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8845 | 6.51 | 4.19 | 2.50 | 32.55 | 54.64 | 6.12 | 24.94 |
| Average of 7 others [1] | ..... | 4.92 | 2.31 | 32.15 | 51.26 | 9.36 | ..... |
| Average of all | ..... | 4.83 | 2.33 | 32.20 | 51.69 | 8.95 | ..... |

[1] Colorado Bul. 12, p. 113. Nevada Bul. 62, p. 24. Wyoming: Bul. 70, p. 48; Bul. 76, p. 50; Bul. 87, p. 70.

### PHRAGMITES COMMUNIS Trin.

*Phragmites communis*, commonly distributed in the United States, and indeed throughout the entire Northern Hemisphere, is a characteristic species of reedlike grass, inhabiting marshes and edges of ponds and streams. It is not usually considered much of a forage plant, but in closely grazed regions it is frequently resorted to in times of scarcity and furnishes really a great deal of supplemental feed. In some situations, where the soils are wet in spring and dry in midsummer, the grass is cut for hay and makes a fair quality of very coarse roughage.

No. 8808 was collected at Fargo, N. Dak., August 10, 1907. The specimen was in full blossom and was cut 1 foot high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8808 | 5.27 | 8.48 | 2.97 | 32.91 | 46.93 | 8.71 | 24.70 |
| One other sample [1] | ..... | 7.14 | 2.87 | 39.02 | 41.86 | 9.11 | ..... |
| Average of both | ..... | 7.80 | 2.92 | 35.97 | 44.40 | 8.91 | ..... |

[1] South Dakota Bul. 40, p. 106.

### PLEURAPHIS MUTICA Buckl.

*Pleuraphis mutica* is the galleta of the southwestern United States and is in many respects a very valuable species. Like the closely related tabosa (*Hilaria jamesii*) of regions a little farther north, it comes into prominence during seasons of excessive drought. It is peculiarly adapted to shallow swales, which catch or retard a portion

of the run-off of the desert during the rainy season. In such situations in southern Arizona, often upon desert mesas, small crops of this grass are sometimes harvested as hay. The prime importance, however, of this and closely related species is from a pasture standpoint. It is a hard, brittle-stemmed, brash species, but the stems are perennial, remaining green from year to year, the new growth springing from near the base. On this account it furnishes a feed that is often more palatable to stock after long periods of drought than even the gramas. Taking it all in all, it is not to be compared as a feed with blue grama or with *Hilaria cenchroides*, but the perennial character of the stems renders it exceptionally valuable after other feeds have become desiccated so as to be of little value.

No. 7014 (Wooton) was collected near Congress Junction, Ariz., February 18, 1912. This sample represents the grass in its winter condition and was prepared by taking the lower 4 or 5 inches of the stems and leaves, cut about 1 inch above the ground. No. 8600 was collected near Deming, N. Mex., September 29, 1906. The specimen was overripe, but all excepting the upper portion of the culm was still green. It was so harvested as to include nothing but this year's growth.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7014 (E. O. W.) | 5.96 | 7.27 | 1.17 | 34.68 | 52.68 | 4.20 | 26.72 |
| Our sample No. 8600 | 4.37 | 8.55 | 2.06 | 29.70 | 52.17 | 7.52 | 24.52 |
| One other sample[1] | ..... | 7.80 | 1.26 | 35.83 | 48.47 | 6.64 | ..... |
| Average of all | ..... | 8.17 | 1.66 | 32.77 | 50.32 | 7.08 | ..... |

[1] New Mexico Bul. 17, p. 37.

**POA ARIDA Vasey.**

In many respects *Poa arida* is one of the most remarkable species of this genus. It has methods of propagation exactly comparable to the common cultivated Kentucky bluegrass, but its rootstocks are much longer and it is a salt-loving species of excellent quality. In many situations in the Rio Grande Valley, especially north of El Paso, and in the Pecos Valley, in the vicinity of Roswell, it is found abundantly mixed with *Distichlis spicata* and *Sporobolus airoides*. It never makes a perfect stand, but grows scatteringly, as indicated above, among other salt-loving grasses, and it is certainly relished by stock. It grows large enough to be cut for hay, and its seed habits are as good as those of Kentucky bluegrass.

No. 8363 was collected near Albuquerque, N. Mex., June 2, 1906. The specimen was in a rather overripe condition and was cut off close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8363 | 4.02 | 7.02 | 1.99 | 33.51 | 51.88 | 5.60 | 25.43 |
| Average of 2 others[1] | ..... | 7.20 | 2.87 | 38.38 | 45.92 | 5.63 | ..... |
| Average of all | ..... | 7.14 | 2.58 | 36.76 | 47.90 | 5.62 | ..... |

[1] Montana Report, 1902, p. 60; South Dakota Bul. 40, p. 28.

### POA BIGELOVII Vasey & Scribn.

*Poa bigelovii* is a typical species of the Mexican-boundary region of Arizona. What its habits were originally we do not know, but at the present day it grows almost invariably in the protection of shrubbery in the foothills at an altitude of 3,500 to 5,000 feet. It seems to desire protection from the sun as well as from live stock. In these situations it furnishes a small quantity of grazing of a fairly good quality. It undoubtedly is not as good feed as the perennial species of Poa, but it grows in this region as a winter and early-spring annual when the stock feed is made up almost entirely of weedy, nongrass forage plants.

No. 9167 was collected in the foothills of the Santa Rita Mountains, Arizona, April 10, 1908. The sample was nearly mature and was cut close to the ground. Its percentage of moisture was 9.30. Other constituents (on a water-free basis) were as follows: Ash, 7.35; ether extract, 2.93; crude fiber, 24.39; nitrogen-free extract, 58.26; protein, 7.07; pentosans, 16.37.

### POA LAEVIGATA Scribn.

*Poa laevigata*, although somewhat distantly related to the common cultivated bluegrass, is quite wiry, but it is still a very important pasture and hay grass in the edges of moist bottoms of the interior Great Basin and Rocky Mountain regions. The situations most suitable for its development are those which receive one or possibly two good floodings during the year. This is characteristic of the heavy, hard, adobe soils between the lower moist bottoms and the surrounding ridges in the eastern part of this range and of the sinks and swales of the Great Basin. In such situations, this species often grows luxuriantly, in almost perfect stand, and will sometimes cut 1½ tons of hay to the acre. It makes a good quality of hay and, when properly handled, a good grade of pasture. Its seed habits are as good as those of Kentucky bluegrass.

No. 8840 was collected at Virdon, Mont., August 14, 1907. The specimen was overmature. It was cut about 1 inch above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8840 | 4.36 | 5.04 | 2.56 | 33.96 | 55.11 | 3.33 | 27.32 |
| One other sample [1] | ..... | 10.96 | 2.17 | 38.27 | 42.87 | 5.73 | ..... |
| Average of both | ..... | 8.00 | 2.37 | 36.11 | 48.99 | 4.53 | ..... |

[1] Montana Report, 1902, p. 66.

### POA NEMORALIS L.

*Poa nemoralis* is a valuable species which reaches its characteristic development in woodland meadows and has a wide distribution in both the North American and Eurasian continents. There are few species that possess such an altitudinal variation of distribution. It ranges from 2 or 3 inches in height at the snow line to 2 feet or more in favored situations at the base of the mountain. While it is an important grass and one relished by all kinds of live stock, it is never abundant enough to be of first importance. It commonly grows in large isolated bunches in favorable situations at lower levels; higher up in the mountains the bunches are smaller and the plants more dwarfed. In palatability to stock and general characteristics of value it stands very close to Kentucky bluegrass. Its habits of growth, however, are not as good. Its seed habits are just as desirable for a cultivated species as those of Kentucky bluegrass.

No. 8869 was collected at Summit, Mont., August 15, 1907. The specimen was in early blossom and was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8869 | 7.52 | 5.89 | 1.69 | 31.06 | 52.84 | 8.52 | 22.84 |
| Average of 9 others [1] | | 6.30 | 2.69 | 32.01 | 51.47 | 7.53 | |
| Average of all | | 6.26 | 2.59 | 31.92 | 51.60 | 7.63 | |

[1] Connecticut Report, 1888, p. 101; 1889, p. 248. Mississippi Report, 1895, p. 92. Montana Report, 1902, p. 66. New York Report, 1886, p. 365. South Dakota Bul. 40, p. 130. Wyoming Bul. 87, p. 82.

### POA ORCUTTIANA Vasey.

*Poa orcuttiana* is a species which is characteristic of the western slope of the southern Sierras. It is a highly prized, important pasture grass. Like some of the other species of the *P. buckleyana* group, it grows in large bunches. At the present time the weedy bromes and fescues are the most conspicuous grasses in the upper foothills, where this species grows, and are much less palatable to live stock. This grass is, therefore, closely cropped upon all the pasture lands of the section. In the localities where the specimen cited below was secured, it grew in almost pure stands on steep, bare, northern slopes of the mountains.

No. 9103 was collected at Caliente, Cal., March 24, 1908. The sample was in very early blossom and was cut as close to the ground as practicable. Its percentage of moisture was 1.65. Other constituents (on a water-free basis) were as follows: Ash, 7.96; ether extract, 3.21; crude fiber, 31.72; nitrogen-free extract, 48.02; protein, 9.09; pentosans, 24.29.

### POA SCABRELLA Benth.

*Poa scabrella* is a palatable species of bluegrass, but strictly of secondary importance, because it never occurs abundantly. It is found in open gravelly ground and also in partial shade of timber throughout the Pacific States from Oregon southward. It was doubtless formerly of much more importance before the native plants were replaced by the introduced annuals now everywhere dominant in the region.

No. 7116 (E. O. W.) was collected at Moorpark, Cal., April 18, 1913. The specimen was just coming into flower. Its percentage of moisture was 6.59. Other constituents (on a water-free basis) were as follows: Ash, 5.30; ether extract, 2.24; crude fiber, 35.22; nitrogen-free extract, 50.68; protein, 6.56; pentosans, 26.50.

### POLYPOGON MONSPELIENSIS (L.) Desf.

*Polypogon monspeliensis* is a foreign, annual, short-bearded grass, widely introduced in this country from Maine to California. It is especially abundant in moist alluvial soils of the Great Basin and California regions. Its best growth is attained in the edges of fresh-water ponds and streams where the warm waters are but 2 or 3 inches in depth. In such small areas it often forms a pure growth and attains a height of 12 to 24 inches. It is readily eaten in the green condition by stock.

No. 8879 was collected near The Dalles, Oreg., August 22, 1907. The sample was completely dried up and was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8879 | 6.99 | 11.26 | 2.21 | 26.93 | 53.39 | 6.21 | 21.99 |
| One other sample [1] | | 11.88 | 2.95 | 21.89 | 50.95 | 12.33 | |
| Average of both | | 11.57 | 2.58 | 24.41 | 52.17 | 9.27 | |

[1] Colorado Bul. 12, p. 99.

FIG. 1.—A GENERAL VALLEY PASTURE, MADE UP OF PANICUM OBTUSUM, CHLORIS ELEGANS, SPECIES OF BOUTELOUA, AND VARIOUS WEEDY PLANTS.

FIG. 2.—VALOTA SACCHARATA IN MOUNTAIN FOOTHILLS, SOUTHERN ARIZONA.

### PUCCINELLIA AIROIDES (Nutt.) Wats. and Coult.

*Puccinellia airoides* is distinctly a salt-grass, and it is much more palatable to stock than most grasses which inhabit salt marshes. It is not only able to withstand large amounts of soluble salts in the soil, but will grow in situations where water holding a large amount of the same ingredients in solution stands on the ground for a month or more at a time. Indeed, it is in the edge of salt waters of this kind that the species appears to be at home. When found, it is usually growing almost to the exclusion of everything else, but commonly in very restricted areas, from northern Arizona northward through the Great Basin and Great Plains regions.

No. 8814 was collected at Devils Lake, N. Dak., August 11, 1907. The sample was from overripe specimens growing in the edge of brackish waters. It was cut at the surface of the water 2 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8814 | 4.58 | 7.86 | 2.67 | 31.72 | 49.20 | 8.55 | 25.89 |
| Average of 2 others [1] | ..... | 7.50 | 2.44 | 33.46 | 51.19 | 5.41 | ..... |
| Average of all | ..... | 7.62 | 2.52 | 32.88 | 50.53 | 6.45 | ..... |

[1] Montana Report, 1902, p. 66; Wyoming Bul. 65, p. 30.

### SCLEROPOGON BREVIFOLIUS Philippi.

*Schleropogon brevifolius* is a peculiar-awned, stoloniferous, rigid-leaved species, inhabiting the drier situations of the arid Southwest. Sometimes it is the only vegetation over considerable areas, and it makes almost a continuous cover only in rare instances. It is difficult to conceive of stock being driven to such an extremity as to eat this species. Such, however, sometimes is the case, but it is only rarely observed to be touched.

No. 8601 was collected near Deming, N. Mex., September 29, 1906. The sample was all green with the exception of the spike, which was entirely dead and dry. Many old leaves were attached to the base of the culm and consequently were included in the sample, which was cut close to the ground. Its percentage of moisture was 3.56. Other constituents (on a water-free basis) were as as follows: Ash, 8.59; ether extract, 2.02; crude fiber, 30.41; nitrogen-free extract, 51.20; protein, 7.78; pentosans, 26.94.

### SITANION BREVIFOLIUM J. G. S.

As a filler in barren places, among rocks, and in the shade of bushes *Sitanion brevifolium* is of secondary importance only. It extends throughout the highland region from Wyoming into northern Mexico.

No. 7142 (E. O. W.) was collected in the San Andreas Mountains, N. Mex., May 23, 1913. The specimen was in full head, but not yet in blossom.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7142 (E. O. W.) | 4.48 | 9.52 | 2.24 | 34.50 | 45.56 | 8.18 | 27.70 |
| One other sample [1] | ..... | 10.68 | 2.31 | 36.72 | 40.84 | 9.45 | ..... |
| Average of both | ..... | 10.10 | 2.27 | 35.61 | 43.21 | 8.81 | ..... |

[1] Wyoming Bul. 87, p. 86.

### SITANION LONGIFOLIUM J. G. S.

The genus Sitanion in general does not contain grasses which are considered to be of much value for either pasture or hay. *Sitanion longifolium*, however, grows in large clumps and furnishes a small amount of very valuable grazing up to the time it heads out. After this the awns and brittle spikes are very annoying, but when these have disappeared, in late maturity, it is again relished by stock. The feed produced by it appears to be of very fair quality early in the season, but it is small in amount.

No. 9555 was collected near Prescott, Ariz., Sept. 7, 1908. Its percentage of moisture was 7.08. Other constituents (on a water-free basis) were as follows: Ash, 7.02; ether extract, 2.18; crude fiber, 35.08; nitrogen-free extract, 47.89; protein, 7.83; pentosans, 26.69.

### SITANION PUBIFLORUM J. G. S.

So far as forage value is concerned, the remarks under *Sitanion longifolium* apply equally well to *S. pubiflorum*.

No. 8341 was collected near Ashfork, Ariz., May 30, 1906. The specimen was completely headed out, but was mostly under blossom. It was cut 1½ to 2 inches high. Its percentage of moisture was 8.13. Other constituents (on a water-free basis) were as follows: Ash, 19.51; ether extract, 1.55; crude fiber, 31.64; nitrogen-free extract, 38.59; protein, 8.71; pentosans, 12.18.

### SPARTINA CYNOSUROIDES (L.) Willd.

The giant cord-grass (*Spartina cynosuroides*) is a familiar species in lowland pastures and meadows of the States as far west as Colorado and Texas. Like the other two species of this genus discussed in this report, it is rank, tough, and wiry, but in spite of this it makes a very fair quality of hay and is readily grazed by stock, especially when young. The hay it produces, if cut in proper season and when not too rank, is of very good quality and weighs heavily. Its natural habitat is in moist bottoms and swales, where it may often be found growing almost pure, but never forming tussocks. On the other hand, like *S. gracilis*, the culms are isolated, and it propagates almost entirely by running rootstocks.

No. 8796 was collected near Fargo, N. Dak., August 10, 1907. The sample was in late blossom in an entirely green and fresh condition, but coarser than is usually cut for hay. It was harvested 3 inches above the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8796 | 5.03 | 7.20 | 1.77 | 37.50 | 46.16 | 7.37 | 26.04 |
| Average of 19 others [1] | ..... | 6.10 | 2.27 | 36.75 | 47.22 | 7.66 | ..... |
| Average of all | ..... | 6.16 | 2.25 | 36.79 | 47.16 | 7.64 | ..... |

[1] Canada Central Experiment Farm Bul. 19, p. 32. Connecticut Report, 1889, p. 245. Iowa: Bul. 11, pp. 456, 478; Bul. 56, pp. 506, 507. Montana Report, 1902, p. 67. South Dakota: Bul. 40, p. 94; Bul. 114, p. 546. U. S. Department of Agriculture Report No. 32, 1884, p. 125.

### SPARTINA GRACILIS Trin.

*Spartina gracilis* is the species commonly known as the small cord-grass, in contradistinction to the giant cord-grass (*S. cynosuroides*). Unlike the larger species, this one seldom, if ever, grows in pure stands. On the other hand, it is found in scattering individuals among other vegetation, from the Dakotas and Kansas westward to California. It is almost invariably found in somewhat alkaline soils, in moist situations in river and lake bottoms, and other places of a similar nature. It is a tough, wiry

species, but in spite of this it is a valuable adjunct to the hay crops where it is included and is readily grazed by cattle.

No. 8881 was collected at The Dalles, Oreg., August 22, 1907. The sample represents the plant in a state of early maturity, cut 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8881 | 6.05 | 9.58 | 1.92 | 31.95 | 51.79 | 4.76 | 23.80 |
| Average of 3 others [1] | | 7.00 | 2.02 | 36.30 | 46.39 | 8.29 | |
| Average of all | | 7.65 | 2.00 | 35.21 | 47.74 | 7.40 | |

[1] South Dakota Bul. 69, p. 9. Wyoming: Bul. 76, p. 58; Bul. 87, p. 88.

### SPARTINA JUNCIFORMIS Engelm. and Gray.

*Spartina junciformis* is also a salt-loving plant, being found along the Gulf coast from Texas to Florida. It is usually accepted by stockmen as an indication of the presence of common salt in the soils. Among the Mexican population of southwest Texas the grass is universally known as sacahuiste, and this is the common popular designation of the plant even among the Americans. It is an exceedingly important and useful grass from many points of view. It is largely grazed along the coast and is often the mainstay during long periods of drought, and some herds live on it continuously. Cattle and horses will eat the old growth when driven to it, but the common way of handling it is to burn the old grass off in small areas at intervals of two or three weeks, thus covering the entire pasture and furnishing fresh growth during the entire season. Stock appear to be fond of this young growth.

This species has been in the past, and is to some extent yet, extensively used as a thatch plant, and it appears to the casual observer much better adapted for this purpose than for forage. Its durability is certainly remarkable when properly laid upon roofs. Buildings have been seen which were thatched with this grass over 30 years ago and are still in fairly good condition.

Like *Sporobolus airoides*, which inhabits alkaline soils in more interior situations, *Spartina junciformis* has two distinct habits of growth. About the inland limit of its development it is likely to be found in very large, compact bunches, while closer to the coast, where conditions are more favorable and its growth is consequently more abundant, its bunch character is to a large extent obliterated.

No. 9064 was collected near Cactus, Tex., March 12, 1908. The sample consists of young growth, 4 to 6 inches high, and probably none of it was over three weeks old. Its percentage of moisture was 3.67. Other constituents (on a water-free basis) were as follows: Ash, 12.33; ether extract, 1.97; crude fiber, 31.05; nitrogen-free extract, 46.28; protein, 8.37; pentosans, 23.59.

### SPOROBOLUS AIROIDES Torr.

*Sporobolus airoides*, to which the name alkali saccaton has been applied by some, is one of the most important native pasture and hay grasses of the alkaline river and lake bottoms from South Dakota to Texas and westward. In some sections it is known as salt-grass. It has two distinct habits of growth. In portions of the valley of the Rio Grande and its tributaries, particularly the Pecos, it forms a continuous, smooth, quite uniform growth, approaching a turf. In other situations it grows in bunches. On the whole, the latter is the more common and characteristic aspect. While able to withstand large amounts of soluble salts in the soil, such conditions do not appear to be necessary for its perfect development. Upon the saline bottoms of the valley of the Little Colorado in Arizona, for instance, it may make a uniform growth, or it may grow in bunches 2 feet high; and upon the sandy bluffs and hillsides, under still

more arid conditions, the plants, although scattering, may be fully as tall, although bearing fewer culms. It withstands much abuse in the shape of close grazing and trampling by stock, especially upon the bottom lands where soils are heavy and hard. In sandy areas, of course, it is easier to kill out. In the Pecos Valley in New Mexico, injury has been done to cattle by allowing them to graze upon this grass at certain seasons of the year. It is the opinion of close observers, however, that the grass was not at fault, but that the injury was done by the soluble salts in the soil, these salts, by creeping up the grass stems during moist weather and by being eaten along with the grass, produce the deleterious effects.

There are very extensive areas of this grass in the Cheno Valley of northern Arizona, which, owing to overgrazing, resemble the tussocky condition of *Sporobolus wrightii*, described later. It is evident that the condition produced by overgrazing, if continued, will gully out the valley to such an extent that the bottom lands will be as unproductive as the hills surrounding. In the year 1908, 1 to 1½ tons of hay to the acre of this grass could be cut upon the lands which had not become tussocky.

No. 8324 was collected at Bakersfield, Cal., May 27, 1906. The specimen grew on apparently nonalkaline, well-drained, sandy-loam soil, where the ground had been disturbed somewhat, producing magnificent large bunches of the plant. The sample was cut when the seed was in the dough, 2 to 3 inches above the ground, care being taken to include all of the root leaves. No. 8575 was collected at Tempe, Ariz., September 24, 1906. The sample grew in what appeared to be strongly alkaline soil. It was a much smaller sample than No. 8324 and was cut close to the ground when the seed was nearly mature.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8324 | 6.10 | 9.62 | 1.63 | 32.56 | 48.20 | 7.99 | 25.92 |
| Our sample No. 8575 | 2.79 | 12.48 | 1.62 | 33.04 | 46.17 | 6.69 | 24.04 |
| Average of 7 others[1] | ..... | 7.63 | 1.83 | 32.02 | 49.41 | 9.11 | ..... |
| Average of all | ..... | 8.39 | 1.78 | 32.19 | 48.92 | 8.72 | ..... |

[1] Colorado Bul. 12, p. 74. New Mexico Bul. 17, p. 36. Wyoming: Bul. 76, p. 60; Bul. 87, p. 89.

### SPOROBOLUS ASPERIFOLIUS Thurber.

*Sporobolus asperifolius* is a species that can be justly considered one of the salt-grasses of this country. It is almost invariably found in salty bottom lands from the Mississippi westward. Its habit of growth, by creeping rootstocks, and its partiality for heavy adobe soils make it one of the most persistent grasses under heavy grazing. It is not as much relished by stock as many species, but it probably is about equal to the familiar salt-grass *Distichlis spicata*. It never gets tall enough, excepting when growing among other grasses, to be cut for hay, and when in pure stands it is almost impossible to cut it with a mower.

No. 8819 was collected at Devils Lake, N. Dak., August 11, 1907. The sample was cut close to the ground and represents the species in early blossom.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8819 | 7.43 | 9.69 | 2.92 | 27.83 | 52.84 | 6.72 | 28.94 |
| Average of 2 others[1] | ..... | 6.80 | 2.00 | 36.64 | 49.04 | 5.52 | ..... |
| Average of all | ..... | 7.76 | 2.31 | 33.70 | 50.31 | 5.92 | ..... |

[1] Mississippi Report, 1888, p. 33; South Dakota Bul. 40, p. 80.

### SPOROBOLUS AURICULATUS Vasey.

Such species as *Sporobolus auriculatus* are in the aggregate of considerable importance, as they add a great deal to the sum total of the pasturage. This one is never abundant enough to give character to the vegetation. It is apparently of limited distribution in southwestern Texas and southern New Mexico. It commonly occurs on more or less alkaline soils.

No. 7083 (E. O. W.) was collected on the mesas near Las Cruces, N. Mex., October 3, 1912. Its percentage of moisture was 3.85. Other constituents (on a water-free basis) were as follows: Ash, 10.46; ether extract, 2.26; crude fiber, 33.42; nitrogen-free extract, 48.11; protein, 5.75; pentosans, 25.72.

### SPOROBOLUS BREVIFOLIUS (Nutt.) Scribn.

*Sporobolus brevifolius* is a short-leaved, tough, wiry, low, drop-seeded grass, a common and even conspicuous species upon dry second bottoms, hillsides, and upland prairies, especially of the Great Plains region. It forms a complete ground cover in only very limited areas, but is commonly scattered among other grasses and is an important ingredient of the make-up of the forage cover of the rolling prairies. The quality of feed produced by it, whether hay or pasture, is low, probably largely on account of its tough, wiry nature. Under conditions of short pasturage, however, it is always closely grazed.

No. 8829 was collected at Williston, N. Dak., August 11, 1907. The sample represents the plant in early maturity, cut at the surface of the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8829 | 5.76 | 9.94 | 2.83 | 30.88 | 50.87 | 5.48 | 26.83 |
| Average of 4 others [1] | ..... | 6.47 | 2.29 | 33.90 | 50.24 | 7.10 | ..... |
| Average of all | ..... | 7.16 | 2.40 | 33.30 | 50.37 | 6.77 | ..... |

[1] Montana Report, 1902, p. 66. Wyoming: Bul. 70, p. 32; Bul. 87, p. 88.

### SPOROBOLUS CRYPTANDRUS (Torr.) Gray.

Although tough and wiry, like the other species of the genus, *Sporobolus cryptandrus* is of great importance, along with some of the closely related forms, especially upon the sandy bench and mesa lands of Arizona and New Mexico. Its distribution, however, is very wide, extending from here to New England. It furnishes a great deal of feed in the Southwestern States.

No. 8395 was collected near Green, Tex., August 14, 1906. The sample was fully mature, but only a little of the seed had shattered. It was cut about 2 inches high. No. 9553 was collected at Prescott, Ariz., September 7, 1908. The plant was ripe, but still green, and it was cut close to the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8395 | 6.59 | 7.48 | 1.38 | 34.71 | 47.66 | 8.77 | 23.07 |
| Our sample No. 9553 | 6.43 | 6.36 | 1.30 | 31.30 | 54.09 | 6.95 | 20.09 |
| Average of 2 others [1] | ..... | 7.19 | 1.80 | 33.98 | 49.17 | 7.86 | ..... |
| Average of all | ..... | 7.05 | 1.57 | 33.49 | 50.03 | 7.86 | ..... |

[1] Montana Report, 1902, p. 66; Wyoming Bul. 87, p. 90.

### SPOROBOLUS FLEXUOSUS (Thurber) Rydb.

*Sporobolus flexuosus* is a familiar species of rather wiry but palatable grass, inhabiting sandy lands from southwestern Texas to Nevada. It grows in scattering small bunches, 2 feet or more high. In some situations it grows almost pure, but it never makes a thick stand. Commonly on the looser sands it is found only in scattering bunches among other species. It is palatable to stock in all stages and is consequently closely grazed.

No. 7073 (E. O. W.) was collected near Las Cruces, N. Mex., September 21, 1912. No. 8602 was collected at Deming, N. Mex., September 29, 1906. It was fully mature, but still green. It was harvested about 1 inch high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7073 (E. O. W.) | 3.57 | 6.00 | 1.23 | 35.94 | 51.29 | 5.54 | 24.64 |
| Our sample No. 8602 | 4.57 | 6.99 | 1.39 | 32.07 | 50.97 | 8.58 | 22.86 |
| Average of both | 4.07 | 6.49 | 1.31 | 34.01 | 51.13 | 7.06 | 23.75 |

### SPOROBOLUS GIGANTEUS Nash.

*Sporobolus giganteus* is one of the most striking of the species of "dropseed," growing invariably in sandy, loose lands, especially in New Mexico and western Texas. It grows scatteringly in large clumps with culms 3 or 4 feet high and furnishes a large amount of pasturage.

No. 7068 (E. O. W.) was collected on the sand hills northeast of Las Cruces, N. Mex., September 8, 1912. Its percentage of moisture was 4.32. Other constituents (on a water-free basis) were as follows: Ash, 5.77; ether extract, 0.98; crude fiber, 43.47; nitrogen-free extract, 45.46; protein, 4.32; pentosans, 25.63.

### SPOROBOLUS INDICUS (Trin.) R. Br.

*Sporobolus indicus*, a characteristic species of the Southern States, is said to have been introduced from tropical regions, although it often has all the appearance of a native species. Being coarse and early becoming woody, it is a grass of secondary importance, but where feed is scarce, and especially in waste places and partially disturbed ground, it toften makes a good growth and furnishes considerable grazing.

No. 8724 was collected at Jacksonville, Fla., June 8, 1907. The sample represents plants in full fruit, but perfectly green. They were cut at the surface of the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8724 | 5.50 | 8.18 | 1.94 | 29.88 | 54.43 | 5.57 | 27.68 |
| Average of 3 others[1] | ..... | 6.99 | 3.80 | 23.87 | 53.05 | 12.29 | ..... |
| Average of all | ..... | 7.29 | 3.33 | 25.37 | 53.40 | 10.61 | ..... |

[1] Connecticut Report, 1879, p. 153; South Carolina Report, 1888, p. 132; U. S. Department of Agriculture Report No. 32, 1884, p. 126.

### SPOROBOLUS GRACILIS (Trin.) Merrill.

*Sporobolus gracilis* is a tough, wiry species to which some have applied the name rush-grass. Indeed, it resembles in texture some of the wiry rushes and produces a feed not unlike them in texture. So far as our experience goes, it is not a grass relished by stock. It inhabits dry, sandy areas from Virginia southward. It is especially common in open pine woods.

No. 8731 was collected at Sutherland, Fla., June 14, 1907. The sample was collected in full blossom by being cut close to the ground. Its percentage of moisture was 6.55. Other constituents (on a water-free basis) were as follows: Ash, 3.43; ether extract, 2.05; crude fiber, 35.35; nitrogen-free extract, 53.88; protein, 5.29; pentosans, 30.29.

### SPOROBOLUS NEALLEYI Vasey.

Nealley's rush-grass is a hard, wiry species, inhabiting the gypsum soils of western Texas and eastern New Mexico. It and *Bouteloua breviseta* grow thriftily upon stable "gyp" soils, containing as high as 95 per cent of calcium sulphate. It is of value only because it is one of the few grasses which will grow in such situations and so produce a forage crop where otherwise none would be possible.

No. 7099 (E. O. W.) was collected upon the white sands west of Alamogordo, N. Mex., October 21, 1912. Its percentage of moisture was 6.16. Other constituents (on a water-free basis) were as follows: Ash, 9.27; ether extract, 1.61; crude fiber, 36.26; nitrogen-free extract, 43.60; protein, 9.26; pentosans, 21.79.

### SPOROBOLUS RAMULOSUS Kunth.

*Sporobolus ramulosus* is one of the annual species of drop-seeded grass of very little value, although it is grazed to some extent by sheep. It grows only in loose temporary sand washes and depressions. It is small, light, delicate, and not of much value.

No. 9538 was collected at Prescott, Ariz., September 1, 1908. Its percentage of moisture was 6.88. Other constituents (on a water-free basis) were as follows: Ash, 7.35; ether extract, 2.22; crude fiber, 30.56; nitrogen-free extract, 50.08; protein, 9.79; pentosans, 23.93.

### SPOROBOLUS STRICTUS (Scribn.) Merrill.

Although rather tough and hard, *Sporobolus strictus* is a very important pasture grass in many of the sandy regions of Arizona, New Mexico, and western Texas. It is well adapted to dry, sandy soils, where it grows scatteringly to a height of 2 to 2½ feet, producing for the region a large quantity of apparently nutritious feed. It is readily grazed by stock, and where close pasturing occurs it is invariably closely cropped.

No. 8947 was collected in the foothills of the Santa Rita Mountains, Ariz., September 24, 1907. The sample, although green, had fully matured its seed. It was a rank specimen and was cut 3 inches high. Its percentage of moisture was 7.14. Other constituents (on a water-free basis) were as follows: Ash, 6.87; ether extract, 1.13; crude fiber, 35.42; nitrogen-free extract, 50.93; protein, 5.65; pentosans, 21.59.

### SPOROBOLUS VIRGINICUS (L.) Kunth.

*Sporobolus virginicus* is a familiar grass of the Southern States that grows mostly in medium-sized bunches and propagates by running rootstocks. Like most species of this genus, it is tough and wiry, but it appears to be quite extensively grazed where the specimen was collected. It is of especial interest, inasmuch as it secretes a salty substance with which the entire vegetative portion may be covered, much like *Distichlis spicata*, *Leptochloa viscida*, and some other western grasses.

No. 8732 was collected at Sutherland, Fla., June 14, 1907. The sample was collected when the plant was in full blossom, and was harvested close to the ground. Its percentage of moisture was 8.46. Other constituents (on a water-free basis) were as follows: Ash, 13.27; ether extract, 2.28; crude fiber, 29.41; nitrogen-free extract, 46.44; protein, 8.60; pentosans, 25.88.

### SPOROBOLUS WRIGHTII Scribn.

*Sporobolus wrightii* is the "sacaton" of the Mexicans, and it is confined to the southwestern United States and Mexico. In former times it was a beautiful, characteristic species of the river bottoms of the Southwest, forming dense growths 6 and even 8 feet in height, through which it was difficult to ride on horseback. At the present time there are but faint traces of this magnificent growth left. Some notion of its habit of growth can be obtained from Plate I in Bulletin No. 4 of the Bureau of Plant Industry, United States Department of Agriculture. Like *Sporobolus airoides*, it has two distinct habits of growth, depending upon the location in which it is found and the treatment which it receives. As near as can be judged, it made a quite uniform stand over portions of the Santa Cruz bottoms in southern Arizona in early days, but of late years it grows almost invariably in large tussocks and at present there is very little of it left. In the valley east of the Baboquivari Mountains in Arizona, we have a fine illustration of the effect of overgrazing on this grass; likewise, a good illustration of its importance in preventing erosion. There are here pastures which were formerly covered with a tall, smooth, uniform growth of saccaton. The grass is now in huge bunches and this bunched condition is directly traceable to paths cut in every direction by cattle. Invariably, when this species is grazed this condition is produced, until the tussocks are often a foot in height. Of course, when the grazing is carried to sufficient excess, one or more of these paths become cut to a sufficient depth in the center of the valley to carry off the water very rapidly. Side branches form and the tussocks are left high in the air, receiving but scant moisture. Under this condition they soon die, and a great deal of the bottom land in southern Arizona is to-day in this condition. In many places the tussocks have disintegrated and disappeared altogether. (Pl. VIII, fig. 1.)

No. 8400 was collected near Green, Tex., August 14, 1906. The sample was collected in full blossom, the entire plant being green except the lower leaves, which were dead and dry. It was cut 4 inches high. Its percentage of moisture was 8.59. Other constituents (on a water-free basis) were as follows: Ash, 8.53; ether extract, 1.70; crude fiber, 32.27; nitrogen-free extract, 47.93; protein, 9.57; pentosans, 25.89.

### STIPA COMATA T. and R.

*Stipa comata* is a coarse species of needle grass of the western Plains region, where it replaces the more eastern *S. spartea*. The pasturage and hay produced by it are both of medium quality, but when found in hay meadows it is difficult to cut the grass at exactly the proper time for the best quality of hay. The sharp-pointed fruits of this grass sometimes injure stock to some extent. On this account, cutting the grass after the seeds have fallen has been recommended. At this stage, however, it has deteriorated somewhat in value and, inasmuch as it matures earlier than the other prairie grasses, it can not be cut before the seeds have become old enough to be injurious. Sheep grazing upon the prairies are sometimes injured by having the seeds of this grass work into the fleece. Mowing, close grazing, or the removal of the flocks from the localities where the plant grows at the time it is maturing its seed are the remedies which have been suggested. Fortunately, the seeds drop to the ground very soon after they mature and cause no further annoyance.

No. 8824 was collected at Williston, N. Dak., August 11, 1907. The culms of the sample were all dead and dry and the seeds had fallen, with the exception of those included in the expanded sheath. It was cut at the surface of the ground.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8824 | 5.83 | 6.62 | 3.65 | 33.09 | 50.66 | 5.98 | 29.67 |
| Average of 8 others [1] | ..... | 6.71 | 2.15 | 34.56 | 49.61 | 6.97 | ..... |
| Average of all | ..... | 6.70 | 2.31 | 34.40 | 49.73 | 6.86 | ..... |

[1] Colorado Bul. 12, p. 70. Montana Report, 1902, pp. 60, 66. Nevada Bul. 62, p. 22. South Dakota Bul. 69, p. 17. Wyoming: Bul. 76, p. 62; Bul. 87, p. 93.

### STIPA EMINENS Cav.

*Stipa eminens* (needle grass) is one of the original valuable perennials of California, which is found as far east as Texas and south into Mexico. It is a valuable, palatable species, but has been so much reduced in quantity by close grazing that it is now of very secondary importance. It occurs commonly as a filler in rocky, broken country, and is of some use as a spring feed.

No. 7069 (E. O. W.) was collected upon limestone hills in the foothills of the San Andreas Mountains, near Las Cruces, N. Mex., September 8, 1912. Its percentage of moisture was 4.82. Other constituents (on a water-free basis) were as follows: Ash, 6.53; ether extract, 2.37; crude fiber, 38.57; nitrogen-free extract, 45.38; protein, 7.15; pentosans, 28.19.

### STIPA RICHARDSONII Link.

Although it always grows scatteringly upon dry hillsides and in open pine timber, *Stipa richardsonii* furnishes many a relished morsel of feed to cattle throughout the region in which it thrives. It always grows in scattering large bunches and is invariably closely grazed.

No. 8878 was collected at Columbia Falls, Mont., August 17, 1907. The sample was mature and was cut close to the ground. Its percentage of moisture was 6.06. Other constituents (on a water-free basis) were as follows: Ash, 6.45; ether extract, 2.07; crude fiber, 35.88; nitrogen-free extract, 50.54; protein, 5.06; pentosans, 28.37.

### STIPA SETIGERA Presl.

*Stipa setigera* is decidedly conspicuous in southern California, growing like many of the other species of the genus in large, tall, spreading bunches often 3 feet in height. It appears to make a very fair quality of pasturage, but is never abundant enough to give a distinctive character to the forage outside of very circumscribed areas, and nowhere does it form a complete stand.

No. 7040 (E. O. W.) was collected near San Luis Obispo, Cal., April, 1912. No. 8288 was collected near Banning, Cal., May 14, 1906. This sample was nearly mature and was cut about 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 7040 (E. O. W.) | 5.29 | 10.35 | 1.50 | 34.64 | 46.32 | 7.19 | 28.35 |
| Our sample No. 8288 | 6.75 | 6.11 | 1.64 | 39.16 | 47.87 | 5.22 | 29.76 |
| Average of both | 6.02 | 8.23 | 1.57 | 36.90 | 47.20 | 6.20 | 29.05 |

### STIPA VASEYI Scribn.

*Stipa vaseyi* (common needle grass) is widely scattered throughout the Rocky Mountain region from southern Montana southward. Although commonly very closely grazed and in many instances nearly, if not quite, exterminated by stock, it has a very bad reputation in some localities. It is known in the Southwest, especially through portions of New Mexico, as sleepy grass, and it is said to have at certain times a very deleterious effect on live stock, especially horses, which graze upon it. The reliable information concerning it, however, is very meager, and requires confirmatory experimentation. It is an interesting fact that the species is very closely related, and, indeed, is considered by some to be doubtfully distinct from what has repeatedly been pronounced a valuable species in the Northwest, namely, *Stipa viridula*. There appear to be no complaints against this latter species from the Dakotas, Montana, or Wyoming, where it is most abundant. In places, the sleepy grass is quite a conspicuous ingredient of native hay. No complaints have come to our attention regarding its effect upon stock when fed to them in a dry condition. In some seasons, comparatively large quantities of it are included in the hay cut upon native meadows in the Cimarron Canyon of New Mexico.

No. 9468 was collected in the Sacramento Mountains of New Mexico, August 5, 1908. The specimen was in early blossom and was cut 3 inches high. Its percentage of moisture was 8.10. Other constituents (on a water-free basis) were as follows: Ash, 7.80; ether extract, 2.77; crude fiber, 34.08; nitrogen-free extract, 41.30; protein, 14.05; pentosans, 20.17.

### STIPA VIRIDULA Trin.

As has been stated, *Stipa viridula* is closely related to and sometimes considered indistinguishable from the sleepy grass of the Southwest. It may be looked upon as the northern extension of that species, but it apparently lacks any injurious qualities which the other may have. It grows commonly in large bunches in dry soils and is especially partial to soils which have been somewhat disturbed by scanty cultivation. It has been called feather bunch-grass, but the name is not in very common use. The quality of its hay appears to be very good and it is readily grazed by live stock.

No. 8813 was collected near Fargo, N. Dak., August 11, 1907. The sample represents the plant practically mature, half of the seed having dropped off. It was harvested 2 inches high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8813 | 6.24 | 9.79 | 2.34 | 33.18 | 46.36 | 8.33 | 25.67 |
| Average of 4 others [1] | ..... | 7.61 | 2.68 | 30.30 | 50.61 | 8.80 | ..... |
| Average of all | ..... | 8.04 | 2.61 | 30.87 | 49.77 | 8.71 | ..... |

[1] Colorado Bul. 12, p. 66; Montana Report, 1902, pp. 60, 66, 67; South Dakota Bul. 40, p. 58.

### SYNTHERISMA SANGUINALIS (L.) Dulac.

The crab-grass (*Syntherisma sanguinalis*), like many other species, is a vile weed in some sections; in others it is a valuable forage plant. It is remarkable in its persistency and volunteers from seed year after year, often against such tenacious species as Kentucky bluegrass, which may often make a beautiful lawn in the spring only to be disfigured later in the year by brown patches of this weedy crab-grass. It is an introduced species, widely distributed throughout the country at the present time. In portions of the South it is cut for hay, always as a volunteer crop. In many of the

orange orchards of Florida, where it volunteers abundantly and makes a tremendous growth after the heavy fertilization given the trees, large crops of a fair quality of hay are taken off in the fall. It also volunteers in different sections in cornfields, with other fall hay crops, and usually forms an important ingredient of the fall crop of forage throughout the South.

No. 8730 was collected at St. Petersburg, Fla., June 13, 1907. The sample was at full maturity and was cut close to the ground. It grew in a favorable situation in a cultivated field.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8730 | 5.67 | 9.13 | 2.39 | 25.55 | 55.31 | 7.62 | 17.11 |
| Average of 20 others [1] | ..... | 10.42 | 2.98 | 29.39 | 46.70 | 10.51 | ..... |
| Average of all | ..... | 10.35 | 2.95 | 29.21 | 47.12 | 10.37 | ..... |

[1] Alabama Bul. 127, p. 5. Connecticut Report, 1879, p. 155. Florida Bul. 11, p. 18. Georgia Bul. 6, p. 108. Iowa Bul. 56, p. 486. Kentucky: Bul. 87, p. 116; Report, 1902, p. 302. Louisiana Bul. 34, p. 1175. Mississippi: Bul. 39, p. 159; Report, 1895, pp. 80, 81, 92. Tennessee Bul. 1, vol. 4, p. 7. U. S. Department of Agriculture Report No. 32, 1884, p. 125. Virginia Bul. 180, p. 96.

### TRICHLORIS FASCICULATA Fourn.

The distribution of *Trichloris fasciculata* is usually given as dry plains and mesas, but in our experience it commonly inhabits rather favorable situations in the edges of shallow washes, where it receives some benefit from irrigation. It is distributed from Texas to Arizona and southward into Mexico. It sometimes produces a magnificent growth in limited situations in the Salt River Valley of Arizona, where irrigation or seepage water escapes to lands where it has obtained a foothold. In such situations it impresses one as being a favorable grass for cultivation. Its seed habits, however, are rather against it, although these are better than in a good many species of the Chlorideæ. When it gets sufficient moisture, as it often does under artificial conditions in irrigated districts, it will produce two crops a year, one in spring and the other in midsummer. Upon the open ranges of the Southwest at the present time very little of it is seen except an occasional stray stalk 3 feet or more high growing in the protection of thorny shrubs.

No. 8385 was collected near Encinal, Tex., August 12, 1906. The sample was collected when the seed was fully ripe. A great deal of it shattered, but the straw, leaves, and culms were perfectly green. Many of the root leaves, however, were dead and dry and were included in the sample, which was cut 2 inches high. No. 9426 was collected near Devils River, Tex., July 23, 1908. The specimen was overmature, the seed having all fallen, but the remainder of the plant was green and succulent. It was cut about 1 inch high.

| Material analyzed. | Percentage of moisture. | Water-free basis (per cent). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Ash. | Ether extract. | Crude fiber. | Nitrogen-free extract. | Protein. | Pentosans. |
| Our sample No. 8385 | 9.05 | 11.24 | 1.92 | 12.51 | 66.76 | 7.57 | 21.65 |
| Our sample No. 9426 | 7.59 | 9.11 | 2.55 | 27.06 | 50.26 | 11.02 | 19.35 |
| Average of both | 8.32 | 10.175 | 2.235 | 19.785 | 58.51 | 9.295 | 20.50 |

### TRIDENS MUTICUS (Torr.) Nash.

About the same can be said for *Tridens muticus* as for *T. nealleyi*, but the former is more abundant and, on the whole, a more valuable species. It has a wider range, extending from the Pacific coast to Texas and north into Colorado.

No. 7065 (E. O. W.) was collected upon limestone hills in the foothills of the San Andreas Mountains, near Las Cruces, N. Mex., September 8, 1912. Its percentage of moisture was 5.86. Other constituents (on a water-free basis) were as follows: Ash, 6.04; ether extract, 1.72; crude fiber, 35.05; nitrogen-free extract, 49.75; protein, 7.44; pentosans, 25.27.

### TRIDENS NEALLEYI (Vasey) Wooton and Stand.

In many situations in the mountains and upon stony ridges and knolls in southwestern Texas and southern New Mexico *Tridens nealleyi* assumes considerable importance on account of its abundance. It furnishes considerable grazing and is a persistent species. Like the other members of the genus it is of second quality in palatability.

No. 7097 (E. O. W.) was collected in the San Andreas Mountains, near Las Cruces, N. Mex., September 23 to October 10, 1912. Its percentage of moisture was 4.55. Other constituents (on a water-free basis) were as follows: Ash, 5.98; ether extract, 1.16; crude fiber, 38.02; nitrogen-free extract, 49.05; protein, 5.79; pentosans, 29.13.

### VALOTA SACCHARATA (Buckl.) Chase. (*Panicum lacnanthum*).

*Valota saccharata*, a conspicuous and attractive cotton-topped species of the southwestern United States and of Mexico, is of decided importance to stock interests. Its seed habits, however, are bad, the seed being covered with long silky hairs, rendering it very difficult to handle. It is therefore of doubtful value for domestication. In many situations, especially in the moister places in the desert foothills of Arizona and the plains of Texas, it grows almost pure over large areas and makes a striking appearance. It grows quite readily from seed, notwithstanding the difficulty of handling. The date of its maturity is very variable in the region indicated above, maturing in central Texas in June if conditions are favorable, or in August if they are not. In southern Arizona its period of development is during the rainy season of summer, in July, August, and September. (Pl. IX, fig. 2.)

No. 8399 was collected near Green, Tex., August 14, 1906. The sample was in early maturity, but no seeds had fallen, and the whole plant was perfectly green. It was cut 1½ inches high. Its percentage of moisture was 7.85. Other constituents (on a water-free basis) were as follows: Ash, 11.96; ether extract, 2.38; crude fiber, 29.97; nitrogen-free extract, 45.72; protein, 9.97; pentosans, 20.46.

### ZIZANIOPSIS MILIACEA (Michx.) Doell and Aschers.

The marsh millet (*Zizaniopsis miliacea*) inhabits swamps and banks of streams from Texas eastward and northward to Ohio. It is a tall, rank species, resembling superficially the wild rice of more northern latitudes and from a forage standpoint corresponds very closely to that species. It is always grazed in closely fed pastures, but not until more palatable feeds fail.

No. 9205 was collected at San Antonio, Tex., April 20, 1908. The sample was in blossom and was cut off at the surface of the water about 2 feet high. Its percentage of moisture was 8.77. Other constituents (on a water-free basis) were as follows: Ash, 9.46; ether extract, 1.53; crude fiber, 32.20; nitrogen-free extract, 43.17; protein, 13.64; pentosans, 17.11.

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